INSTRUCTION MANUAL

SD346

SIGNATURE RATIO® ADAPTER

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Spectral Dynamics Division

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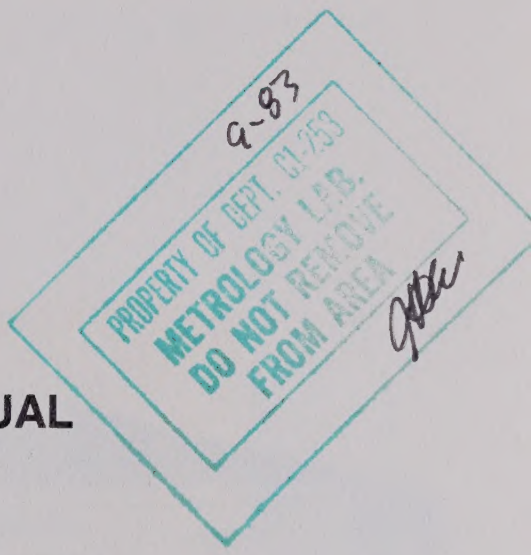

INSTRUCTION MANUAL

SD346

SIGNATURE RATIO® ADAPTER

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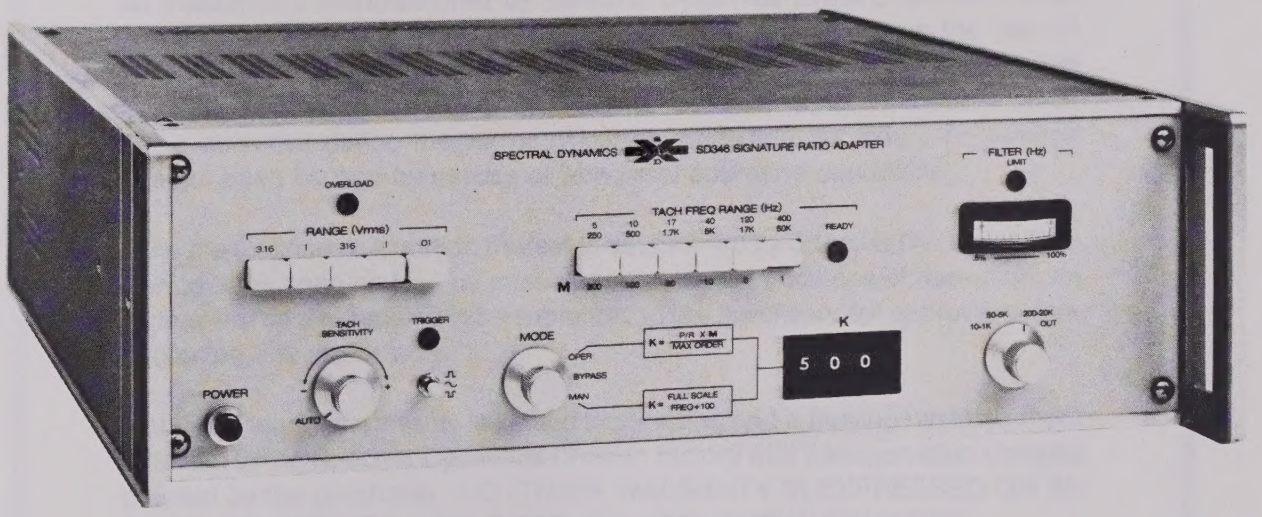
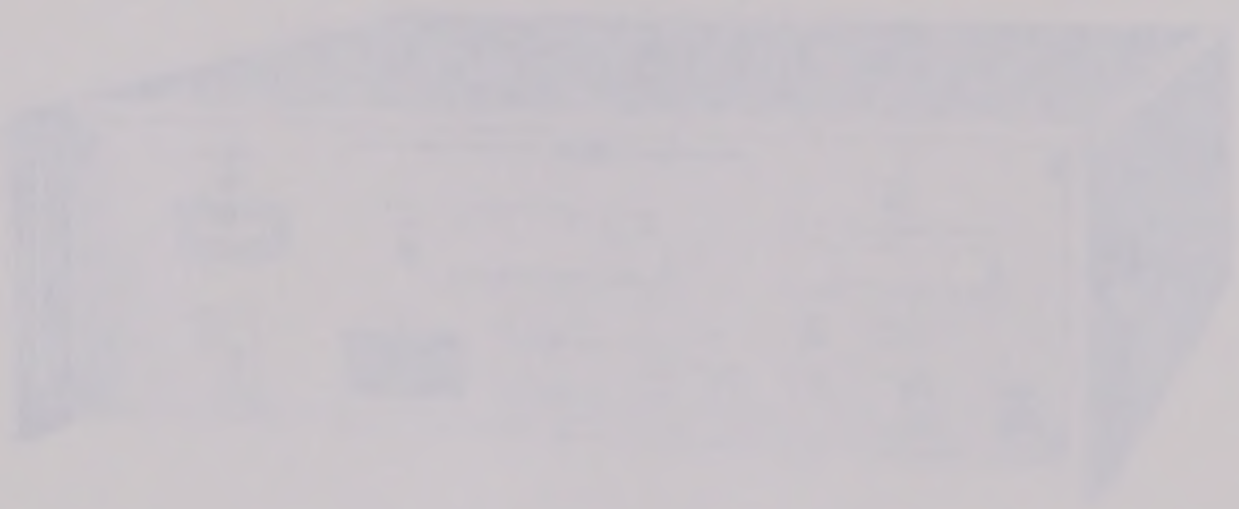


SD346 SIGNATURE RATIO® ADAPTER



INSTRUMENT
WARRANTY POLICY

All instruments manufactured by Spectral Dynamics Division are warranted against defects in materials and workmanship for one year from the date of delivery or, in the case of certain components listed in some of the operating manuals, for the specified period. We will repair or replace products which prove defective during the warranty period, providing the failure or damage has not been caused by misuse or abnormal operating conditions.

If the malfunction or a portion thereof is determined by Spectral Dynamics Division to have been caused by misuse or abnormal conditions of operation, an estimate of cost to repair will be submitted to the purchaser for approval before beginning any repair work.

Liability under this warranty is limited to servicing and adjusting the instrument returned to the Spectral Dynamics Division factory with transportation charges prepaid by the purchaser. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. WE ARE NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

If a malfunction develops, notify the Spectral Dynamics Division Customer Service Department or its representative in your area, giving details of the problem and the name, model and serial number of the equipment. Upon receipt of this information, service data or shipping instructions will be provided.

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains unpacking, initial checkout, operating, maintenance, and calibration instructions for the Scientific-Atlanta Model SD346 Signature Ratio® Adapter. The manual is divided into six sections. This section contains a brief description of the instrument, optional equipment, and accessories furnished.

The manual is written for the operator and for maintenance personnel. It contains external maintenance procedures that the operator can perform without removing the covers or the front panel. The manual also includes internal maintenance and calibration procedures that only qualified service personnel should perform. We recommend that you read each section of the manual in its entirety before you proceed to the next section.

1.2 OTHER DOCUMENTATION

No other documentation is required with this manual.

1.3 EQUIPMENT DESCRIPTION

The Model SD346 Signature Ratio Adapter (SRA) is designed to interface with Scientific-Atlanta analyzers, or with computers through Scientific-Atlanta Digital Signal Processors. Its primary purpose is to provide these analyzers with harmonic-order analysis capability. However, it also provides versatility in the selection of analysis ranges, thus increasing the resolution of some test results even when rotating machinery is not involved. Because of its speed-tracking capability, the SD346 also compensates for speed variations of the playback device when analyzing recorded data.

Based on a tachometer reference frequency from the device under test, the SD346 provides sampling pulses to the analyzer (or computer). These pulses allow the analyzer to track the speed-related vibration components. The dynamic low-pass filter in the SD346 provides continuous protection against aliasing terms, even as the sampling frequency shifts due to rpm changes.

The Model SD346 provides a selection of five sampling rates, making it compatible with the following Scientific-Atlanta instruments:

Model 13180-20 Vibrascope Real Time Analyzer
Model SD210 SpectraTester
Model SD210A SpectraTester
Model SD301 series Real Time Analyzers
Model SD330 series Spectrascope Real Time Analyzers
Model SD335 series Spectrascope II Real Time Analyzers

Model SD340-33 FFT Analyzer
Model SD345 Spectrascope III FFT Analyzer
Model SD360 Digital Signal Processor
Model SD375 Dynamic Analyzer II

Figure 1-1 shows an analyzer and the Signature Ratio Adapter in two typical applications:

a. Plotting Signature Ratio spectrums with harmonic frequencies normalized with respect to main-shaft speed.

b. Plotting a single-order profile.

The SRA continuously supplies the analyzer with the correct sampling frequency to provide order-normalized spectrums. Both the low-pass-filter bandwidth and the sampling frequency change continuously as the rotational speed varies. Hence, the analyzer produces a spectrum output that is a function of the harmonic order number, rather than frequency.

The following abbreviations are used throughout this manual:

f_c Corner frequency of the dynamic low-pass filter; the highest vibration frequency of interest.

f_T Tachometer frequency; the sampling frequency and low-pass-filter corner frequency are derived from f_T.

f_S Sampling frequency; derived from f_T, and controlled by the Ratio Selector.

M Tachometer-frequency multiplier; selected by the TACH FREQ RANGE/M Selector.

K K Selector setting; acts as a divider in the OPER mode and as a multiplier in the MAN mode.

P/R Pulses per Revolution; the number of tachometer pulses generated during each revolution of the main shaft.

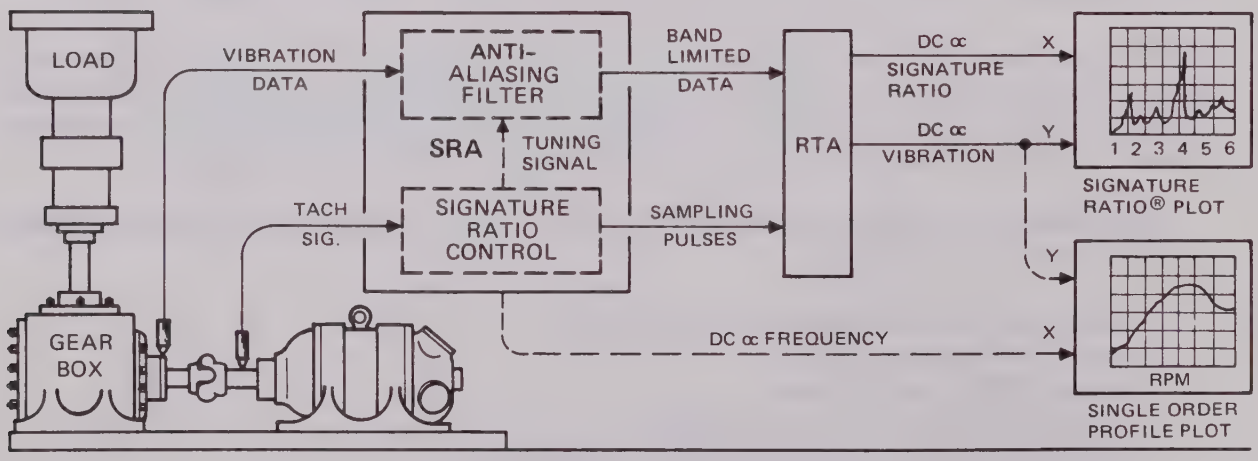


Figure 1-1. System Concept

1.4 REQUIRED EQUIPMENT

The SD346 is an intermediate conversion device requiring two input sources and an output receiving device. The sources required are: a suitable transducer (e.g., a microphone, an accelerometer, etc.), and a tachometer. The receiving device can be any of the Scientific-Atlanta instruments listed in Paragraph 1.3.

1.5 OPTIONAL EQUIPMENT

For greater system flexibility, an X-Y plotter can be added to the equipment listed in Paragraph 1.4. The SD346 provides a signal which can be used for calibrating the plotter, or for plotting a single-order profile.

1.6 ACCESSORY KIT

An accessory kit is furnished with each Model SD346 Signature Ratio Adapter. The kit is packaged separately, and contains the following items:

1 Instruction Manual	(Part No. 21240900)
1 Power Cord	(Belden No. 17952)
2 Rack-Mounting Brackets	(Part No. 21145600)

1.7 SPECIFICATIONS

DATA INPUT

Sensitivity

0.01 Vrms to 3.16 Vrms (selectable in 5 steps).

Input Impedance

100 kΩ (approx.).

Coupling

AC (0.4 Hz = lower 3-dB point).

Frequency Range

0.4 Hz to 50 kHz.

TACH INPUT

Frequency Range (Hz)	Nominal Slew Rate (Hz/s)*
5 – 250	7 – 10
10 – 500	25 – 40
17 – 1.7K	80 – 140
40 – 5K	600 – 1,000
120 – 17K	6,000 – 10,000
400 – 50K	50,000 – 110,000

*Function of input frequency. Higher slew rate applies from f = 1/10th of the frequency range to f_{max}. (The maximum slew rate is 1,200 Hz/s when the SD346 is used with either the SD335 series or the Model SD360.)

Input Impedance

60 kΩ (approx.).

Amplitude

100 mVrms to 30 Vrms (symmetrical waveform).

100 mV to 50V peak (positive or negative pulses, 10 μs minimum pulse width).

DATA (FILTERED) OUTPUT

Frequency Range

0.4 Hz to 50 kHz.

Amplitude

100 mVrms full scale.

Passband (FILTER: 1%–100% of selected range; usable to 0.5%)

0.4 Hz to f_c (f_c equals $f_T \times$ M/K; 20 kHz max.).

Frequency Response

$\pm$ 1 dB, 1.5 Hz to f_c.

Rejection

Greater than 30 dB at twice f_c.

Output Impedance

Less than 250Ω, 3 mA max.

TACH CONDITIONED OUTPUT

TTL level.

SAMPLING OUTPUTS (J7-20 and J7-28)

Frequency

0.9226 Hz to 256 kHz (OPER mode). (f_s equals $f_T \times$ M/K $\times$ sampling rate.)

256 Hz to 256 kHz (MAN mode). (f_S equals 100 $\times$ K $\times$ sampling rate; accurate to better than 0.01% of reading.)

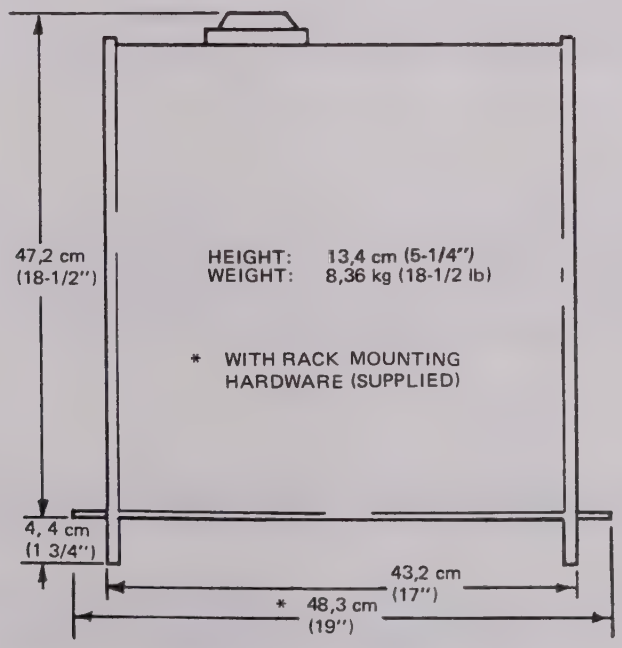
Amplitude

TTL level. Square wave compatible with external sampling controls on instruments listed in Paragraph 1.3.

POWER REQUIREMENTS

105-125/210-250 Vac, 30 Watts, 50/60/400 Hz.

DIMENSIONS



SECTION II

INSTALLATION

2.1 INTRODUCTION

This section contains instructions for performing an initial inspection of your Model SD346 Signature Ratio Adapter. You will also find procedures for submitting a claim for warranty repairs and for packing the instrument for reshipment. The section concludes with a discussion of safety precautions and installation procedures.

2.2 INITIAL INSPECTION

2.2.1 Unpacking

Remove the instrument from its shipping container carefully to avoid damaging the front- and rear-panel controls and connectors. Make sure that each item on the packing list is included with the shipment (accessory kits may be shipped in separate containers). Save the shipping container and all packing materials until the instrument has been inspected for damage and checked for proper operation.

2.2.2 Checking for Damage

Your SD346 was inspected mechanically and electrically before it was shipped. When you receive it, inspect it (and the accessory kit) for damage that may have occurred during shipment. Inspect all panels for dents, scratches, or chipped paint. Check for bent or broken connectors, knobs, and switches. Make sure that all switches and controls operate smoothly. If you find any damage, refer to Subparagraph 2.2.3 of this manual. Also, it may be helpful to photograph the damage for subsequent claims.

2.2.3 Claims

If your SD346 was damaged during shipment, or if it does not operate as specified when you receive it, notify the carrier and the nearest Scientific-Atlanta sales/service office or representative immediately. The local office will arrange for repair or replacement. When you ship the instrument, be sure to attach a card showing the owner's name, address, and telephone number and describing the service required.

2.2.4 Reshipment

If you reship your SD346, use the original shipping container and packing materials. If these are not available, use the following:

a. A double-wall carton with a test strength of 350 pounds. The carton should be large enough to accommodate the packing materials listed below.

b. Heavy paper or sheets of cardboard to protect all surfaces.

c. Nonabrasive material such as polyurethane or cushioned paper between projecting parts and the carton wall.

d. At least 4 inches of shock-absorbing material such as extra-firm polyurethane.

2.3 SAFETY PRECAUTIONS

The Model SD346 Signature Ratio Adapter presents no hazard to operating personnel if operated in accordance with the instructions in this manual. Read the following safety precautions before you attempt to operate your SD346.

2.3.1 Explosion Hazard

Do not operate the SD346 in any environment where flammable vapors may exist. Operating any electrical instrument in such an environment constitutes an explosion hazard.

2.3.2 Shock Hazard

When connected to a properly grounded, three-contact power receptacle, the three-conductor ac power cord supplied with the SD346 grounds the panel and chassis. Grounding protects the operator from possible injury. To preserve this protection when operating from a two-conductor outlet, use a three-conductor-to-two-conductor adapter and connect the adapter wire to ground at the power outlet before you connect the instrument. The covers and safety plates should be removed only by qualified service personnel. Voltages are present inside the SD346 whenever the power cord is connected, even when the power switch is off.

2.4 PREPARATION FOR USE

2.4.1 Power Requirements

The SD346 is designed to operate on either 115 Vac or 230 Vac. Therefore, before you apply power to the instrument, check the following:

a. Make sure that the window on the Line Voltage switch (located next to the transformer on the rear panel) shows the correct line voltage.

b. Make sure that the fuse in the rear-panel fuse holder has the correct value. Use a 1/2 A, SLO-BLO fuse for 115 Vac operation; a 1/4 A, SLO-BLO fuse is required for 230 Vac operation.

2.4.2 Equipment Interconnections

The SD346 may be used with any of the instruments listed in Paragraph 1.3. Section III of this manual contains instructions for connecting the SD346 to each of those instruments.

2.4.3 Mounting

The SD346 is shipped from the factory as a bench instrument. If you want to install it in a rack, use the rack-mounting hardware provided in the accessory kit.

SECTION III

OPERATION

3.1 INTRODUCTION

This section describes all controls and indicators on the Model SD346. In addition, this section describes procedures for initial setup and powering, and for operational checkout. Equipment interconnections, applications, and operator maintenance are also discussed.

3.2 FRONT PANEL DESCRIPTION

Figure 3-1 shows the front panel of the SD346. In the following descriptions, the front-panel controls and indicators are grouped according to function.

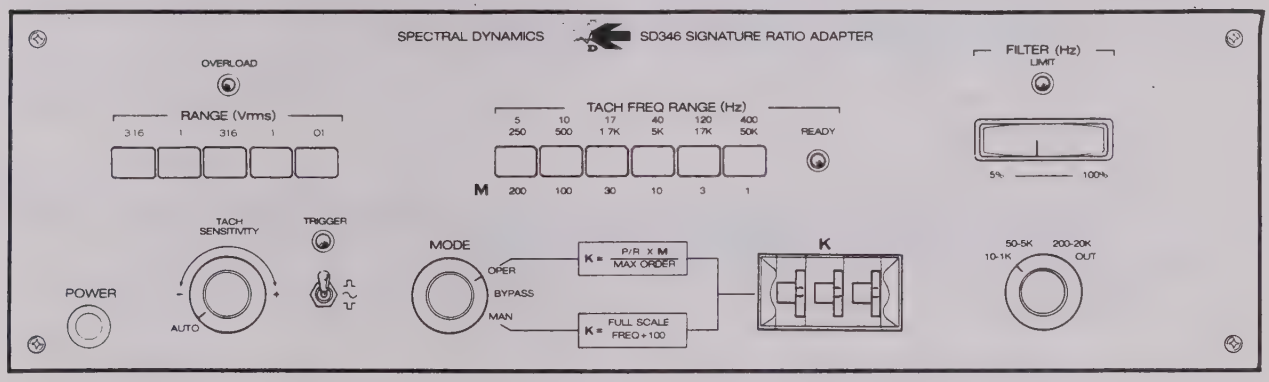
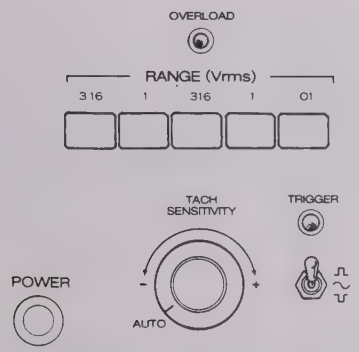


Figure 3-1. Model SD346 Front Panel

3.2.1 Input Group



POWER Switch/Indicator

The POWER switch is used to turn the primary input power on or off. Push the button to turn the power on; push it again to turn the power off. An indicator inside the pushbutton lights when you apply power to the instrument.

RANGE Data Input Attenuator

The RANGE Data Input Attenuator selects the input sensitivity of the data channel. Use the lowest range in which the OVERLOAD indicator remains unlit.

OVERLOAD Indicator

The OVERLOAD indicator lights when the instantaneous peak DATA input signal (including out-of-band signal) exceeds the input sensitivity by approximately 7 dB or more.

Tach Waveform Selector

⎍ Set the selector to this position when the tachometer waveform consists of positive pulses having a duty cycle of approximately 30% or less.

~ Set the selector to this position for any tachometer waveform having a duty cycle greater than 30%.

⎎ Set the selector to this position when the tachometer waveform consists of negative pulses having a duty cycle of approximately 30% or less.

TACH SENSITIVITY Control

AUTO Detent Position

This is the normal operating position; the tach pulse conditioner is triggered at each axis crossing in the ~ mode and at 2/3 of the pulse height in the ⎍ or ⎎ mode.

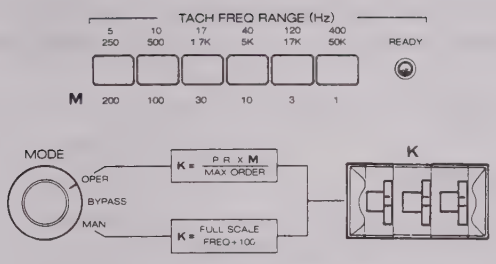
– ⟷ + Variable Range

Use the variable range whenever the AUTO position does not give optimum results. You can adjust the trigger level from the negative peak of the waveform (CCW) to the positive peak of the waveform (CW). Once the level is set, an AGC circuit automatically keeps the trigger level at a constant percentage of peak value. When the control is properly set, the TRIGGER indicator lights, and the waveform at the rear-panel TACH COND connector is "clean" and steady.

TRIGGER Indicator

The TRIGGER indicator remains on as long as the TACH input signal is large enough to trigger the tach conditioning circuits. If the indicator blinks, either the TACH input signal is marginal, or the frequency is below 3 Hz.

3.2.2 Signature Ratio Group



MODE Selector

OPER

This is the normal operating mode of the SD346. The sampling frequency and the corner frequency of the dynamic low-pass filter are derived from the tachometer frequency. Sampling pulses are provided at the rear-panel AUXILIARY FUNCTIONS connector. ($f_c = f_T \times M/K$.)

BYPASS

The data channel is completely bypassed in this mode (the DATA input connector, J1, is shorted to the DATA output connector, J4). The analyzer is switched to internal sampling pulses by the removal of the ground on J7-2 and J7-7.

MAN

In this mode, the sampling frequency and the corner frequency of the dynamic low-pass filter are determined by the setting of the K Selector. Sampling pulses are provided at the rear-panel AUXILIARY FUNCTIONS connector. ($f_c = 100 \times K$.)

TACH FREQ RANGE/M Selector

MODE Selector in OPER

In the OPER mode, the TACH FREQ RANGE/M Selector determines the range of tachometer frequencies than can be accommodated by the Signature Ratio circuitry. Use the highest range that encompasses the actual frequency range to be encountered. For example, a tachometer frequency range of 40 Hz – 1.7 kHz can be accommodated by either the 17 – 1.7K or the 40 – 5K range, but 40 – 5K is better due to the improved slew rate in the higher range.

MODE Selector in MAN

In the MAN mode, the TACH FREQ RANGE/M Selector determines a reference frequency for calibrating an X-Y plotter, using the DC ∝ RPM output.

READY Indicator

The READY indicator lights when the multiplier phase-locked loop (controlled by the TACH FREQ RANGE/M Selector) is tracking theTACH input signal within $\pm 180°$.

K Selector

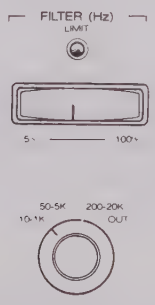
MODE Selector in OPER

In the OPER mode, the K Selector determines the corner frequency of the dynamic low-pass filter according to the expression: $f_c = f_T \times M/K$. (M is determined by the setting of the TACH FREQ RANGE/M Selector.)

MODE Selector in MAN

In the MAN mode, the K Selector determines the corner frequency of the dynamic low-pass filter according to the expression: $f_c = 100 \times K$.

3.2.3 FILTER Group



FILTER Range Selector

The FILTER Range Selector determines the range over which the corner frequency of the dynamic low-pass filter may vary. Use the lowest range that will accommodate the entire vibration frequency spectrum to be analyzed. For example, if vibration frequencies will range from 200 Hz to 5 kHz during testing, then either the 50 – 5K or the 200 – 20K setting will work, but 50 – 5K is better. It is not necessary to know the exact vibration frequency limits; simply vary the engine speed from the lower to the upper test limit and use the lowest range that allows the FILTER meter to stay on scale and the LIMIT indicator to remain unlit. With the FILTER Range Selector in the OUT position, the vibration signal bypasses the low-pass filter.

FILTER Meter

The FILTER meter indicates the corner frequency of the dynamic low-pass filter as a percentage of full scale (i.e., as a percentage of the upper frequency limit established by the FILTER Range Selector). The meter deflection and f_c range from 0.5% to 100% of full scale.

LIMIT Indicator

The LIMIT indicator lights when f_c goes below 0.5% or above 100% of the selected full-scale value.

3.3 REAR PANEL DESCRIPTION

Figure 3-2 shows the rear panel of the SD346. In the following descriptions, the rear-panel controls and connectors are grouped according to function.

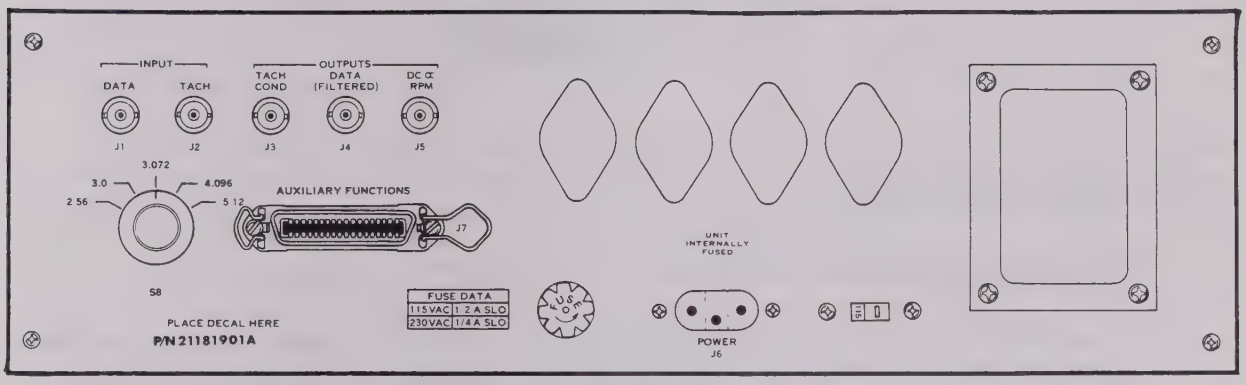
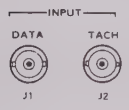


Figure 3-2. Model SD346 Rear Panel

3.3.1 INPUT Group



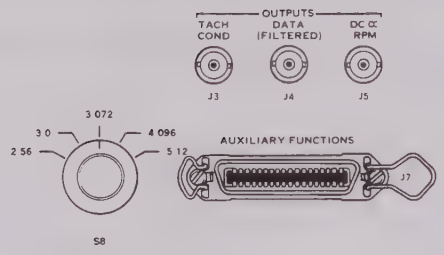
DATA Connector (J1)

The DATA connector receives the vibration signal from the machine under test; the signal will be band limited for Signature Ratio analysis on the analyzer.

TACH Connector (J2)

The TACH connector receives the tachometer output pulses from the machine under test; the pulses will be converted to sampling pulses for the analyzer and converted to a tuning signal for the dynamic low-pass filter.

3.3.2 OUTPUTS Group



TACH COND Connector (J3)

MODE Selector in OPER or BYPASS

In the OPER or BYPASS mode, the TACH COND connector provides the output of the tachometer signal conditioning circuitry. This output can be used to monitor the tachometer signal quality while you determine the best setting for the TACH SENSITIVITY Control.

MODE Selector in MAN

In the MAN mode, the TACH COND connector provides a square wave output at f_c (f_c = 100 × K).

DATA (FILTERED) Connector (J4)

MODE Selector in OPER or MAN

In the OPER or MAN mode, the DATA (FILTERED) connector supplies the band-limited vibration signal to the analyzer. (The vibration signal input at J1 is routed through the input amplifier and dynamic low-pass filter to J4.)

MODE Selector in BYPASS

In the BYPASS mode, the DATA (FILTERED) connector supplies the unprocessed vibration signal to the analyzer. (The vibration signal input at J1 is dc coupled to J4, completely bypassing the Adapter circuitry.)

DC ∝ RPM Connector (J5)

MODE Selector in OPER or BYPASS

In the OPER or BYPASS mode, the DC ∝ RPM connector provides a dc voltage that is continuously proportional to the rpm of the machine under test. The full-scale output is approximately 10V, where $V_{out} = f_T \times M/5000$ Volts.

MODE Selector in MAN

In the MAN mode, the DC ∝ RPM connector provides a dc voltage that is proportional to K. This voltage can be used to calibrate the frequency axis on an X-Y plotter. The full-scale output is approximately 10V, where V_{out} = K × M/50 Volts.

AUXILIARY FUNCTIONS Connector (J7)

The AUXILIARY FUNCTIONS connector provides sampling pulses and sampling pulse control to the analyzer, as listed in Table 3-1.

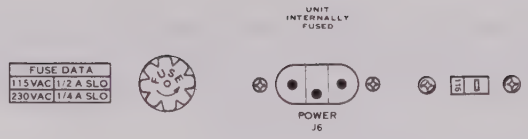
Ratio Selector

The Ratio Selector controls the frequency of the sampling pulses supplied by J7 so as to make the sampling rate compatible with the requirements of the analyzer, as shown in Table 3-1. The frequency of the sampling signal equals f_c times the sampling rate.

Table 3-1. AUXILIARY FUNCTIONS Connector (J7) Functional Description

Pin	Function	Ratio Selector	Scientific-Atlanta Analyzers Used With	Mode	Signal
1	GND				
2 & 7	SAMPLE FREQ CONTROL			OPER MAN BYPASS	GND GND OPEN
9 & 10	GND				
19	GND				
20 & 28	f_s	2.56	SD340-33	OPER	$f_t \times \frac{2.56M}{K}$
			SD210 or SD210A	MAN	256 × K
		3.0	SD301 Series SD330 Series Model 13180-20	OPER MAN	$f_t \times \frac{3.0M}{K}$ 300 × K
		3.072	SD335	OPER MAN	$f_t \times \frac{3.072M}{K}$ 307.2 × K
		4.096	SD360	OPER MAN	$f_t \times \frac{4.096M}{K}$ 409.6 × K
		5.12	SD345 SD375	OPER MAN	$f_t \times \frac{5.12M}{K}$ 512 × K

3.3.3 Power Group



POWER Connector (J6)

The POWER connector accepts a 3-wire plug and cable for applying 115/230 Vac, 50 – 400 Hz power to the SD346. The center terminal is connected to chassis ground. A power cord (Belden Part No. 17952) is supplied with your Adapter for 115 Vac operation.

FUSE Holder

The FUSE holder accepts a 3AG-type power fuse. Use a 1/2 A, SLO-BLO fuse for 115 Vac operation. For 230 Vac operation, use a 1/4 A, SLO-BLO fuse.

Line Voltage Switch

The Line Voltage switch allows you to operate your SD346 on either 115 Vac or 230 Vac. Simply set the switch so that the appropriate line voltage value appears in the window.

3.4 OPERATIONAL CHECKOUT

The following paragraphs describe a checkout procedure for the Model SD346. Use this procedure as a performance check when you receive your instrument; later on, you can use it as a diagnostic check if you suspect that your instrument needs servicing. Make sure you thoroughly understand the front- and rear-panel descriptions before you check out your SD346. Be sure to perform the checkout procedure in its entirety, and perform all steps in the order given.

3.4.1 Equipment Needed

To check out your SD346, you will need the test equipment shown in Table 3-2; instruments having equal or better operating characteristics may be substituted.

3.4.2 Getting Ready

Apply power to the test instruments.

3.4.3 SD346 Initial Powering

a. Make sure that the Line Voltage switch on the rear panel of the SD346 is set to the correct line voltage.

b. Make sure that the power fuse in the rear-panel FUSE holder is the correct size (1/2 A, SLO-BLO for 115 Vac operation, or 1/4 A, SLO-BLO for 230 Vac operation).

Table 3-2. Instruments Needed for Operational Checkout

Instrument	Model No.	Manufacturer
Oscilloscope	561 or 7403N	Tektronix
Sweep Oscillator	SD104A-5	Scientific-Atlanta
Digital Voltmeter	3440A or DS100	Hewlett-Packard Doric
RMS Voltmeter	3400	Hewlett-Packard
Frequency Counter	5223L	Hewlett-Packard
Digital Ohmmeter	3440A with 3444A plug-in	Hewlett-Packard

c. Connect the power cord to the POWER connector on the rear panel of the SD346, and connect the other end to the primary power source.

d. Set the MODE Selector to BYPASS and push the POWER switch pushbutton. The indicator inside the pushbutton should light, showing that power has been applied.

e. Let the SD346 and the test instruments warm up for about fifteen minutes before you proceed with the checkout.

3.4.4 Tach Conditioner Checks

a. Set the following controls as shown:

MODE Selector	—	OPER
M Selector	—	10
TACH SENSITIVITY Control	—	AUTO
Tach Waveform Selector	—	~

b. Connect the oscilloscope to the TACH COND connector, J3.

c. Apply a 100 ± 5 mVrms, 1000 Hz sine wave to the TACH connector, J2. The READY indicator should be lit.

d. Check for a conditioned tachometer signal (square wave) at J3; the TRIGGER indicator should be lit.

e. Vary the signal frequency at J2 from 5 Hz to 50 kHz, and check the signal at J3 for correct triggering over the entire range. The TRIGGER indicator should remain lit.

f. Change the signal level at J2 to 10 Vrms, and check the signal at J3 for correct triggering from 5 Hz to 50 kHz. The TRIGGER indicator should remain lit.

g. Change the signal level at J2 to 1 Vrms, then gradually lower the frequency below 5 Hz. The TRIGGER indicator should start flickering at about 3.5 Hz (2 to 4.5 Hz).

3.4.5 K Selector Checks

a. Set the following controls as shown:

MODE Selector — MAN
Ratio Selector — 3.072

b. Connect the frequency counter to J3.

c. Set the K Selector as shown in the table below. For each setting, wait for the READY indicator to light, then check for the indicated frequency at J3.

K	Frequency at J3 (Hz)
001	100 ± 0.1
009	900 ± 1
010	1,000 ± 1
090	9,000 ± 1
100	10,000 ± 1
500	50,000 ± 2
525	52,500 ± 2

d. Connect the frequency counter to J7-20/28.

e. Set the K Selector as shown in the table at the top of page 3-11. For each setting, wait for the READY indicator to light, then check at J7-20/28 for the frequency indicated for each position of the Ratio Selector.

3.4.6 Bandwidth Control Checks

a. Set the following controls as shown:

MODE Selector — MAN
FILTER Range Selector — 200 – 20K
K Selector — 100

K	Frequency at J7-20/28 (Hz)				
	Ratio Selector				
	2.56	3.0	3.072	4.096	5.12
001	256	300	307	409	512
009	2,304	2,700	2,765	3,686	4,608
010	2,560	3,000	3,072	4,096	5,120
090	23,040	27,000	27,648	36,864	46,080
100	25,600	30,000	30,720	40,960	51,200
500	128,000	150,000	153,600	204,800	256,000
525	134,400	157,500	161,280	215,040	268,800

b. The FILTER meter should read approximately half scale, and the LIMIT indicator should be off.

c. Set the K Selector to 020. The FILTER meter should read one minor division (one-tenth of full scale), and the LIMIT indicator should remain off.

d. Set the K Selector to 001. The FILTER meter should read .5%, and the LIMIT indicator should flicker on and off.

e. Sequentially set the K Selector to each value from 195 to 203. The LIMIT indicator should light between K = 198 and K = 202; the FILTER meter should read full scale.

f. Set the K Selector to 525. The LIMIT indicator should remain on, and the FILTER meter should read full scale.

g. Set the K Selector and the FILTER Range Selector as shown in the table below. For each combination, check for the indicated FILTER meter reading and LIMIT indicator condition.

K	FILTER Range Selector	Meter (Approx.)	LIMIT Indicator
001	10 – 1K	0.1	OFF
005	10 – 1K	0.5	OFF
010	10 – 1K	1.0	ON or OFF
011	10 – 1K	1.0	ON
005	50 – 5K	0.1	OFF
025	50 – 5K	0.5	OFF
050	50 – 5K	1.0	ON or OFF
051	50 – 5K	1.0	ON

3.4.7 M Selector Checks

a. Set the following controls as shown:

MODE Selector — OPER
K Selector — 001

b. Connect the frequency counter to J7-20/28.

c. Connect the constant-amplitude-square-wave output of the SD104A-5 to J2, and set the frequency to 250 ± 1 Hz.

d. Set the M Selector as shown in the table below. For each setting, wait for the READY indicator to light, then check at J7-20/28 for the frequency indicated for each position of the Ratio Selector.

M	Frequency at J7-20/28 (Hz)				
	Ratio Selector				
	2.56	3.0	3.072	4.096	5.12
200	128,000	150,000	153,600	204,800	256,000
100	64,000	75,000	76,800	102,400	128,000
30	19,200	22,500	23,040	30,720	38,400
10	6,400	7,500	7,680	10,240	12,800
3	1,920	2,250	2,304	3,072	3,840
1	640	750	768	1,024	1,280

e. Set the M Selector as shown in the table below. For each setting, vary the frequency at J2 between the indicated limits; the READY indicator should remain lit over the entire range.

M	Frequency Range at J2 (Hz)	READY Indicator
200	4 – 260	ON
100	8 – 525	ON
30	12 – 1,750	ON
10	30 – 5,250	ON
3	110 – 17,500	ON
1	250 – 52,500	ON

f. Connect the digital voltmeter to the DC ∝ RPM connector, J5.

g. Set the M Selector to 1.

h. Set the frequency at J2 as shown in the table below. For each setting, wait for the READY indicator to light, then check for the indicated voltage at J5.

Frequency at J2 (Hz)	DC Voltage at J5
500	100 mV
5,000	1 V
50,000	10 V

i. Set the MODE Selector to MAN.

j. Set the M Selector and the K Selector as shown in the table below. For each combination, wait for the READY indicator to light, then check for the indicated voltage at J5.

M	K	DC Voltage at J5
200	002	8 V
30	005	3 V
1	500	10 V

3.4.8 Input Amplifier Checks

a. Set the following controls as shown:

MODE Selector — OPER
FILTER Range Selector — OUT

b. Connect the RMS voltmeter to the DATA (FILTERED) connector, J4.

c. Apply a 10 mVrms, 100 Hz sine wave to the DATA connector, J1.

d. Set the RANGE Attenuator and the sine wave amplitude as shown in the table at the top of page 3-14. For each combination, check for the indicated voltage at J4.

e. Set the RANGE Attenuator to .1, and set the amplitude at J1 to 0.1 Vrms. Gradually increase the input at J1 until the OVERLOAD indicator just lights. The input required at J1 should be 0.22 $\pm$ 0.02 Vrms.

f. Set the signal amplitude at J1 to 0.1 Vrms.

RANGE Attenuator	Input at J1 (Vrms)	Voltage at J4 (Vrms)
.01	0.01 ± 0.0001	0.100 ± 0.002
.1	0.1 ± 0.001	0.100 ± 0.002
.316	0.316 ± 0.003	0.100 ± 0.002
1	1 ± 0.01	0.100 ± 0.002
3.16	3.16 ± 0.03	0.100 ± 0.002

g. Set the MODE Selector to MAN. The output at J4 should be a sine wave at approximately 0.1 Vrms.

h. Set the MODE Selector to BYPASS. The output at J4 should be a sine wave at approximately 0.1 Vrms.

i. Turn off the power to the SD346. The output at J4 should not change from step *h*.

j. Reapply power to the SD346.

3.4.9 Filter Checks

a. Set the following controls as shown:

MODE Selector — MAN
RANGE Attenuator — .1

b. Apply a 100 ± 1 mVrms sine wave to J1.

c. Set the K Selector, the FILTER Range Selector, and the frequency at J1 as shown in the table at the top of page 3-15. For each combination, check for the indicated output level at J4.

3.4.10 Combined Checks

a. Set the following controls as shown:

MODE Selector — OPER
M Selector — 200
K Selector — 100
RANGE Attenuator — .1
TACH SENSITIVITY Control — AUTO
Tach Waveform Selector — ∿
FILTER Range Selector — 10 – 1K

K	FILTER Range Selector	Frequency at J1 (Hz)	Output at J4 (0.100 Vrms = 0 dB)
001	10 – 1K	50 ± 0.5	0 ± 0.75 dB
001	10 – 1K	100 ± 1	0 ± 0.75 dB
001	10 – 1K	200 ± 2	–30 dB or greater
010	10 – 1K	100 ± 1	0 ± 0.75 dB
010	10 – 1K	1,000 ± 10	0 ± 0.75 dB
010	10 – 1K	2,000 ± 20	–30 dB or greater
005	50 – 5K	500 ± 5	0 ± 0.75 dB
005	50 – 5K	1,000 ± 10	–30 dB or greater
050	50 – 5K	5,000 ± 50	0 ± 0.75 dB
050	50 – 5K	10,000 ± 100	–30 dB or greater
020	200 – 20K	2,000 ± 20	0 ± 0.75 dB
020	200 – 20K	4,000 ± 40	–30 dB or greater
200	200 – 20K	20,000 ± 200	0 ± 0.75 dB
200	200 – 20K	40,000 ± 400	–30 dB or greater

b. Apply a 250 ± 1 Hz, constant-amplitude square wave from the SD104A-5 to J2.

c. From a separate oscillator, apply a 100 ± 1 mVrms, 500 ± 5 Hz sine wave to J1.

d. Check for the following conditions:

OVERLOAD indicator	—	OFF
TRIGGER indicator	—	ON
READY indicator	—	ON
LIMIT indicator	—	OFF
FILTER meter	—	Reads approximately 0.5
Output at J4	—	100 ± 4 mVrms
Output at J3	—	250 Hz, TTL square wave

e. Change the frequency at J1 to 1000 ± 10 Hz. The output at J4 should be at least 30 dB below 100 mVrms.

f. Verify that J7-2/7 is grounded in the OPER and MAN modes and open-circuited in the BYPASS mode and with the power off.

3.4.11 Ratio Selector Checks

a. Set the following controls as shown:

MODE Selector	—	OPER
RANGE Attenuator	—	.1
TACH SENSITIVITY Control	—	AUTO
FILTER Range Selector	—	200 – 20K

b. Connect the frequency counter to J7-20/28.

c. Apply a 0.1 Vrms sine wave to both J1 and J2.

d. Set the M Selector, the K Selector, and the signal frequency at J1/J2 as shown in the table below. For each combination, wait for the READY indicator to light, then check at J7-20/28 for the frequency indicated for each position of the Ratio Selector.

M	K	Frequency at J1/J2 (Hz)	Frequency at J7-20/28 (Hz)				
			Ratio Selector				
			2.56	3.0	3.072	4.096	5.12
200	004	20	2,560	3,000	3,072	4,096	5,120
200	004	200	25,600	30,000	30,720	40,960	51,200
30	003	100	2,560	3,000	3,072	4,096	5,120
30	003	1,000	25,600	30,000	30,720	40,960	51,200
1	005	500	256	300	307	409	512
1	005	5,000	2,560	3,000	3,072	4,096	5,120
1	005	50,000	25,600	30,000	30,720	40,960	51,200

e. Set the MODE Selector to MAN.

f. Set the K Selector and the FILTER Range Selector as shown in the table at the top of page 3-17. For each combination, check at J7-20/28 for the frequency indicated for each position of the Ratio Selector.

FILTER Range Selector	K	Frequency at J7-20/28 (Hz)				
		Ratio Selector				
		2.56	3.0	3.072	4.096	5.12
10–1K	001	256	300	307	409	512
50–5K	010	2,560	3,000	3,072	4,096	5,120
200–20K	100	25,600	30,000	30,720	40,960	51,200
OUT	500	128,000	150,000	153,600	204,800	256,000

3.5 EQUIPMENT INTERCONNECTIONS

NOTE

When the Model SD346 Signature Ratio Adapter is used with a Scientific-Atlanta analyzer that contains dither circuitry, the dither circuitry should be disabled. This is done by setting the analyzer's internal dither switch to the OUT position. Table 3-3 gives the location of the switch in each of the applicable analyzer models. For details, refer to the manual supplied with the analyzer.

Table 3-3. Location of Dither Switch

Analyzer Model	Relevant Serial Numbers	Switch Location
SD335	All	Circuit Card A10
SD301D	541 and up	Circuit Card A12
SD301D-C	97 and up	Circuit Card A12
SD330A	538 and up	Circuit Card A31
SD345	All	Circuit Card A7
SD340	All	Circuit Card A3
SD210 or SD210A	All	Circuit Card A3

Connect the SD346 to your analyzer as shown in Figure 3-3. Appendix A contains the interconnection diagrams for specific analyzers and gives details of the cable assemblies needed. (The cable assemblies must be ordered separately.)

Set the Ratio Selector on the SD346 to the appropriate sampling rate, as specified in Table 3-4.

NOTE

On the SD210, SD210A, or SD340-33, the amplitude of frequency components near full scale will be attenuated somewhat by the low-pass filter in the SD346. To avoid this, set the Ratio Selector to 5.12 and use only the lower half of the display. For convenience, you can blank the upper half of the display by increasing the horizontal gain. In this mode, these analyzers have 200-line displays. The SD345 and SD375 automatically switch to the 200-line-display mode. On the SD360, use only the lower half of the display; you can blank the upper half if you wish.

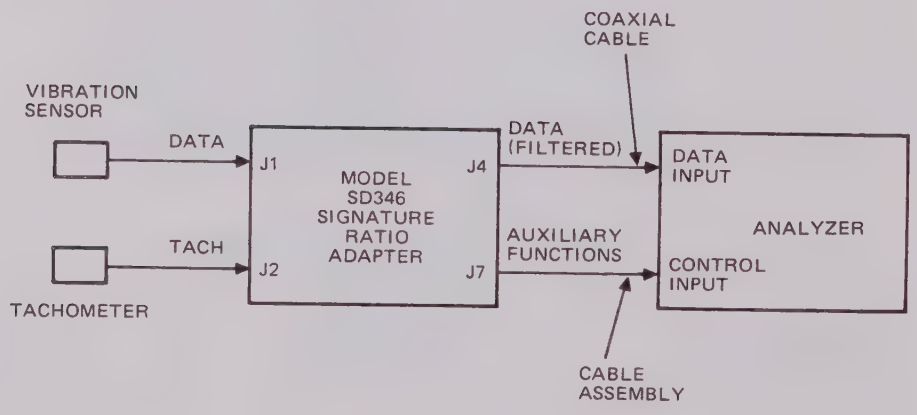


Figure 3-3. Interconnection Diagram for SD346

3.6 APPLICATIONS

The following paragraphs describe some typical applications of the SD346. A few applications are presented with the Model SD345 as the analyzer, in order to allow a more detailed description. If you are using a different analyzer, consult the manual supplied with your analyzer for specific operating instructions.

3.6.1 Signature Ratio Analysis

Figure 3-4 shows the setup for a typical Signature Ratio analysis using a Model SD345 as the analyzer. An electric motor drives a load (almost any type of machinery) through a gear box. The signal of interest in this example is the vibration from the input bearing of the gear box; this signal is to be referenced to the speed of the drive shaft.

Table 3-4. Ratio Selector Settings for Scientific-Atlanta Analyzers

Analyzer	Ratio Selector
SD340-33 SD210 or SD210A	2.56*
SD301 Series SD330 Series Model 13180-20	3.0
SD335	3.072
SD360	4.096*
SD345 SD375	5.12*

*See Note on page 3-18

To prepare for Signature Ratio analysis, follow these steps:

a. Connect all required equipment to the SD346, as discussed in Paragraph 3.5.

b. If auxiliary display or recording devices are to be used, connect them to the analyzer.

c. Apply power to all instruments, and let them warm up for about fifteen minutes before you proceed.

d. Set the controls on the SD346 as follows:

1. Set the MODE Selector to BYPASS.

2. Set the Tach Waveform Selector according to the characteristics of the tachometer signal, as described in Subparagraph 3.2.1.

3. Set the TACH FREQ RANGE Selector to the highest range (lowest M) that includes all tachometer frequencies to be produced during the test. This setting will give the best slew rate. (A higher value of M may be desirable in certain cases; see step *k2* for details.) The READY indicator should remain lit throughout the Signature Ratio analysis.

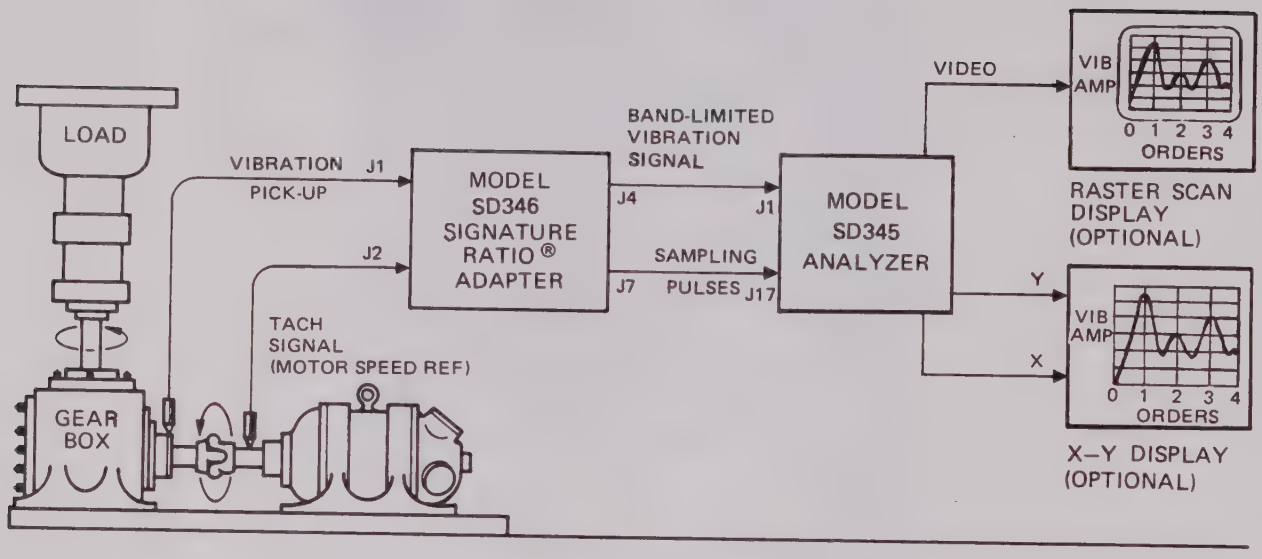


Figure 3-4. Setup for Typical Signature Ratio Analysis with SD345

4. Set the TACH SENSITIVITY Control to AUTO. With the motor running at a convenient speed, the TRIGGER indicator should be lit, and a clean, steady pulse train should appear at the TACH COND connector, J3. If either of these does not occur, take the TACH SENSITIVITY Control out of the AUTO position and adjust the triggering level manually until the TRIGGER indicator remains lit, and a clean, steady pulse train is obtained at J3. Once the TACH SENSITIVITY Control is set, it should be correct for the entire rpm range due to AGC correction.

e. With the motor running at a convenient speed, set the controls on the analyzer (input level, transducer sensitivity, etc.) to produce a suitable display.

f. Set the aliasing-filter bandwidth on the analyzer to an appropriate value. However, do not exceed 20 kHz; otherwise, spurious information might appear on the display.

g. Set the MODE Selector on the SD346 to OPER. The SD345 will automatically switch to the ORDERS display mode.

h. Set the input sensitivity on the analyzer to 100 mVrms. (The input sensitivity on the Model SD360 is given in peak voltage, not rms. Therefore, the input attenuator on the SD360 must be set at –3 dB to compensate.)

i. Set the controls on the SD346 as follows:

1. Set the RANGE Attenuator to the lowest range that will accommodate the highest expected data input level. If this level is not known, run the motor through its range of test speeds (step *i2* may also be performed at this time) and use the lowest RANGE Attenuator setting for which the OVERLOAD indicator remains unlit.

2. Set the FILTER Range Selector to the lowest range that includes all vibration frequencies of interest. If the range of vibration frequencies is not known, run the motor through its range of test speeds and use the lowest FILTER Range Selector setting for which the LIMIT indicator remains unlit and the FILTER meter reads on scale.

j. With the motor running at its maximum test speed, check the analyzer display for signs of an incorrect aliasing-filter bandwidth. Figure 3-5 shows how the display might look when the bandwidth is too small. To make sure that the filter is not attenuating desired information, increase the bandwidth one or two settings above the intended value and check the display. Figure 3-6 shows how the display might appear when the bandwidth is too large — spurious terms are present. Return the bandwidth to the proper value; the display should resemble Figure 3-7. Return the motor's speed to a convenient value.

k. Set the K Selector on the SD346 as follows:

1. Calculate K from the equation

$$K = \frac{(P/R) \times M}{N} \quad ,$$

where N is the order number you want to display at full scale. (It is sometimes necessary to observe harmonic orders that are less than one, as, for example, when studying oil whirl in centrifugal pumps. Most fractional orders are readily observed by using N = 1.) For example, if the tachometer produces 4 pulses per revolution of the main shaft (P/R = 4), and the TACH FREQ RANGE Selector is set to 40 – 5K (M = 10), and you want to display the first 8 harmonic orders of the main-shaft frequency (N = 8), then

$$K = \frac{4 \times 10}{8} = 5 \quad .$$

If K is an integer, set the K Selector to the computed value; in the example above, the K Selector would be set to 005. If K contains a fraction, see step *k2*; otherwise, proceed to step *l*.

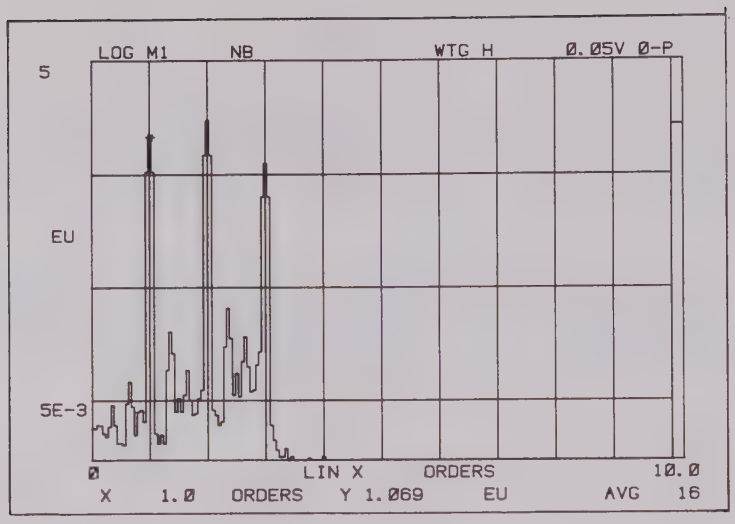


Figure 3-5. Typical Display with Insufficient Bandwidth on Analyzer Aliasing Filter

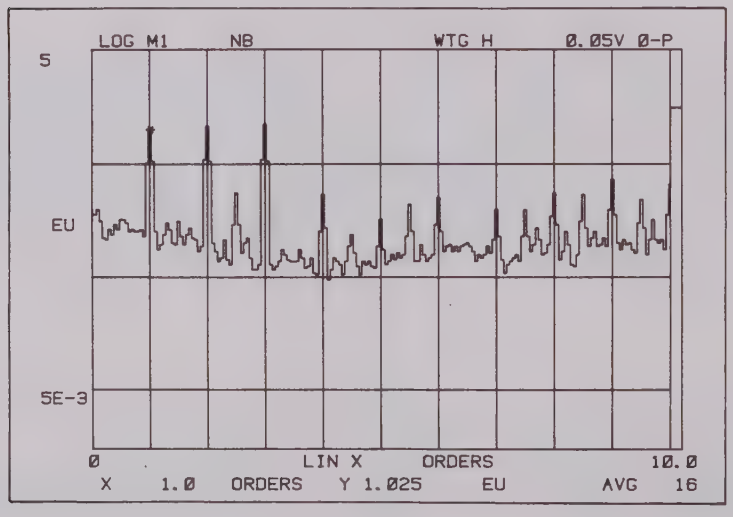


Figure 3-6. Typical Display with Excessive Bandwidth on Analyzer Aliasing Filter

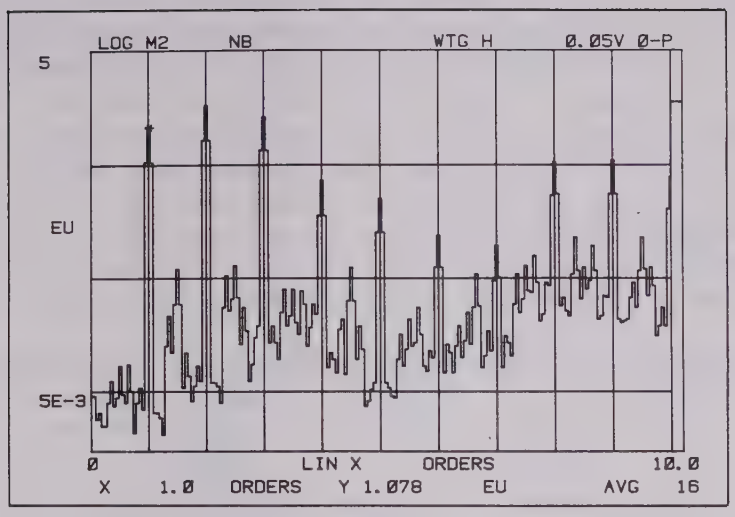


Figure 3-7. Typical Display with Analyzer Aliasing Filter Set Correctly

2. If the computed value of K contains a fraction, set the K Selector to the next lower whole number. If, for example, the computed value of K is 12.7, set the K Selector to 012. For calibrating the display on the analyzer, the actual number of orders at full scale is given by

$$\text{Max. Orders} = \frac{(P/R) \times M}{\text{K-Selector Setting}} \quad .$$

Returning to the example in step *k1*, suppose you want to display the first 13 harmonic orders. Thus,

$$K = \frac{4 \times 10}{13} = 3.1 \quad .$$

Set the K Selector to 003. Then,

$$\text{Max. Orders} = \frac{4 \times 10}{3} = 13.3 \quad .$$

The display will therefore show the first 13.3 harmonic orders of the main-shaft frequency.

For some applications, it may be desirable to display the Nth order exactly at full scale. This is possible only if K is an integer (i.e., if P/R × M is divisible by N). If K initially contains a fraction, it can sometimes be changed to an integer by increasing M. For an example, see Table 3-5, which gives data for a typical Signature Ratio analysis. The table shows the M and K values needed to display various orders at full scale.

For P/R = 1, the tachometer frequency will vary from 20 to 200 Hz; the highest TACH FREQ RANGE Selector setting that will accommodate this range corresponds to M = 30. The fourth order cannot be displayed exactly at full scale for M = 30 and P/R = 1, because K = 7.5. However, by setting the TACH FREQ RANGE Selector to the next lower range which accommodates all of the tachometer frequencies (M = 100), a value of K = 25 is obtained. Thus, the fourth order can be displayed exactly at full scale, although the slew rate will be lower for M = 100. In some cases, P/R must be changed to display the Nth order exactly at full scale.

Table 3-5. Sample Values for a Typical Signature Ratio Analysis

Main-Shaft Speed (rpm)	Full-Scale Orders (N)	P/R	Tachometer Frequency (Hz)	Full-Scale Frequency (Hz)	FILTER Range Selector	FILTER Meter	M	K
1,200 – 12,000*	1	1 60	20 – 200 1,200 – 12,000	20 – 200 20 – 200	10 – 1K 10 – 1K	.02 – .2 .02 – .2	30 1	030 060
	2	1 60	20 – 200 1,200 – 12,000	40 – 400 40 – 400	10 – 1K 10 – 1K	.04 – .4 .04 – .4	30 1	015 030
	3	1 60	20 – 200 1,200 – 12,000	60 – 600 60 – 600	10 – 1K 10 – 1K	.06 – .6 .06 – .6	30 1	010 020
	4	1 60	20 – 200 1,200 – 12,000	80 – 800 80 – 800	10 – 1K 10 – 1K	.08 – .8 .08 – .8	100 1	025 015
	5	1 60	20 – 200 1,200 – 12,000	100 – 1,000 100 – 1,000	10 – 1K 10 – 1K	.1 – 1.0 .1 – 1.0	30 1	006 012
	10	1 60	20 – 200 1,200 – 12,000	200 – 2,000 200 – 2,000	50 – 5K 50 – 5K	.04 – .4 .04 – .4	30 1	003 006
	15	1 60	20 – 200 1,200 – 12,000	300 – 3,000 300 – 3,000	50 – 5K 50 – 5K	.06 – .6 .06 – .6	30 1	002 004
	20	1 60	20 – 200 1,200 – 12,000	400 – 4,000 400 – 4,000	50 – 5K 50 – 5K	.08 – .8 .08 – .8	100 1	005 003

*20 – 200 Hz

l. Check for an order-normalized display on the analyzer.

m. Adjust the controls on the analyzer as follows:

1. Change the transducer-sensitivity setting if necessary. The full-scale output of the data channel on the SD346 is 100 mVrms; hence, the SRA provides unity voltage gain only when the RANGE Attenuator is in the .1 Vrms position. When other positions are used, the transducer-sensitivity setting on the analyzer must be changed to correctly calibrate the vertical scale on the display. On the SD345, the transducer sensitivity is set by the MV/EU Control. The new transducer sensitivity is given by

$$\text{New MV/EU Setting} = \frac{\text{Initial MV/EU Setting}}{\text{Attenuation Factor}} ,$$

where the Initial MV/EU Setting was obtained in step *e*, and the Attenuation Factor is given in Table 3-6. For example, if the Initial MV/EU Setting is 100 mV/EU, and the RANGE Attenuator on the SD346 is set to .316 Vrms, then

$$\text{New MV/EU Setting} = \frac{100 \text{ mV/EU}}{3.16} = 31.6 \text{ mV/EU} \quad .$$

Once the RANGE Attenuator on the SD346 is set, and the MV/EU Control on the SD345 is adjusted accordingly, the input sensitivity on the SD345 can be changed without affecting the vertical-scale calibration.

Table 3-6. Attenuation Factors for RANGE Attenuator Settings

RANGE Attenuator Setting (Vrms)	Attenuation Factor
.01	0.1
.1	1.0
.316	3.16
1	10.0
3.16	31.6

2. Adjust the width of the display, if necessary. (Refer to the Note on page 3-18.)

3. Calibrate the horizontal scale of the display in terms of full-scale orders. On the SD345, move the cursor to the location of the fundamental order, and set the harmonic markers. (Since 200 cells of information are shown on a 400-cell display, two data cells comprise one "display cell". You must therefore move the cursor twice to advance one "display-cell" location. For calibration, move the cursor to the lower half of the "display cell" containing the fundamental order.) Figures 3-8 and 3-9 show a display in which the 10th harmonic order appears at full scale. The fundamental order is stored in data-cell numbers 40 (400/10) and 41. In Figure 3-8, the display was calibrated with the cursor at cell number 40; the full-scale order number is shown correctly as 10.0. In Figure 3-9, cell number 41 was used during calibration. As a result, the full-scale order number is identified incorrectly as 9.8. If necessary, use the fine-alignment controls to align the harmonic markers on the higher orders.

n. If you are using auxiliary display or recording equipment, adjust it as required.

After you complete steps *a* through *n,* proceed with the Signature Ratio analysis. Figure 3-10 shows a typical display on the SD345 during a Signature Ratio test.

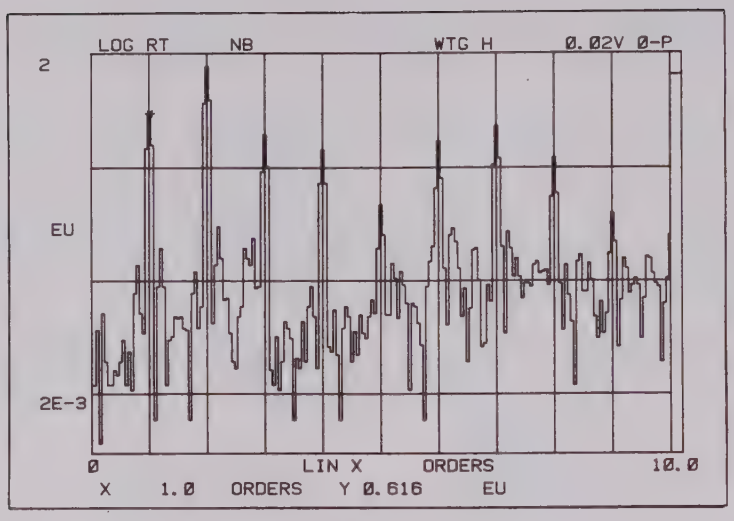


Figure 3-8. Full-Scale-Orders Calibration Using Lower Cell of Fundamental Location

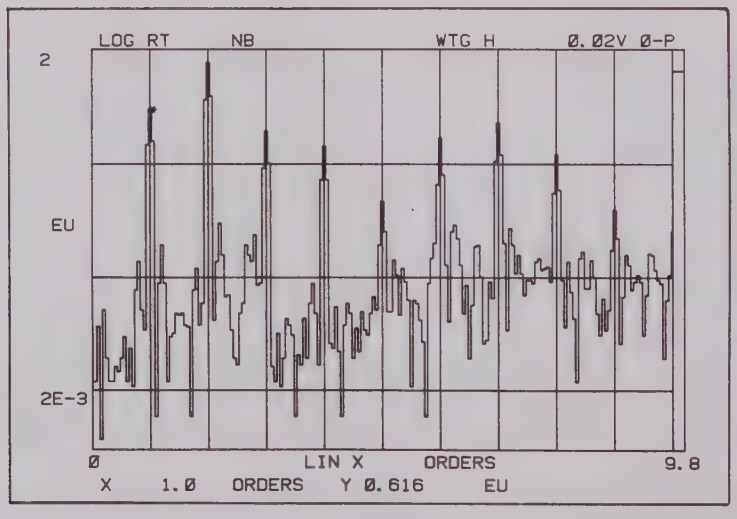


Figure 3-9. Full-Scale-Orders Calibration Using Upper Cell of Fundamental Location

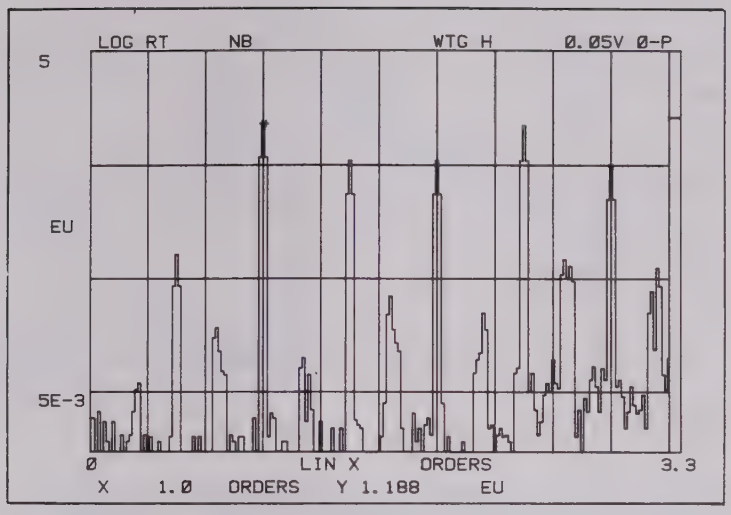


Figure 3-10. Typical Signature-Ratio Display on SD345

Averaging and Zoom analysis (if the analyzer provides them) can be used during Signature Ratio analysis. For best results, follow these guidelines:

a. Averaging can be used with Signature Ratio analysis, but the number of ensembles should be small (about 4 or 8) unless the motor speed is extremely steady. Averaging a large number of ensembles creates a long "time constant," which slows the display's response to new information. Thus, the display may lag far behind if the vibration spectrum changes rapidly. Using a small number of ensembles allows the display to keep up. During run-up and coast-down, use the exponential averaging mode, with about 4 ensembles per average.

b. The peak averaging mode on the SD345 can be used with Signature Ratio analysis to obtain a "worst-case" display, showing the maximum amplitude attained by each harmonic order during the test. (The harmonic orders may not reach their maximum amplitudes simultaneously.) This mode should be used only when the data signal is free of noise or interference, and when structural resonances are small.

c. The Zoom feature on the SD345 can be used during Signature Ratio analysis, but the SD345 will display all 400 data cells. Since only the lower 200 cells contain valid information (refer to Table 3-4 and the Note on page 3-18), confine all Zoom windows to the lower half of the display. If you plan to use the Zoom feature, you must use a different cable assembly to connect the SD345 to the SD346.

The SD346 can be used in Signature Ratio analysis of recorded data, as Figure 3-11 shows. The recorded data signal is applied to J1, and the recorded tach signal is applied to J2. In this configuration, the SD346 automatically compensates for speed variations in the playback device. Thus, the analyzer always produces a steady, order-normalized display. However, if recorded data is used for RPM Tracking (described in Subparagraph 3.6.2), speed variations in the playback device can distort the plotted profiles.

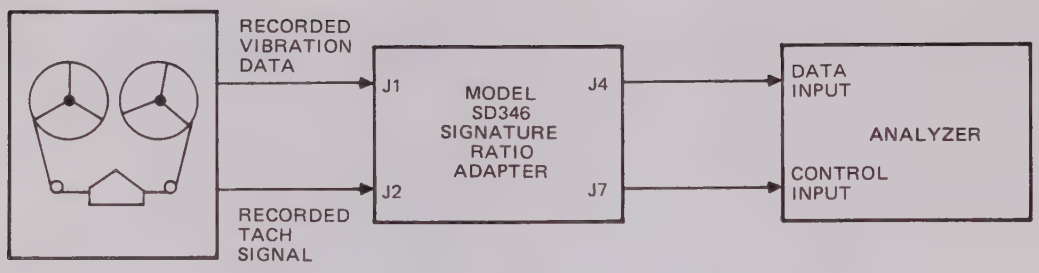


Figure 3-11. Signature Ratio Analysis of Recorded Data

3.6.2 RPM Tracking

Figure 3-12 illustrates the setup for tracking the amplitude of a specific harmonic order as the machine speed is varied. Again, a Model SD345 is the analyzer. The cursor on the analyzer selects the data cell containing the desired order number, and the information in that cell is plotted as a function of rpm.

To prepare for RPM Tracking, follow these steps:

a. Prepare the equipment for Signature Ratio analysis as described in Subparagraph 3.6.1.

b. Connect the X-Y plotter as follows:

   1. Connect a coaxial cable from the SD346 DC ∝ RPM connector, J5, to the X-axis input connector on the plotter.

   2. Connect a coaxial cable from the analyzer's Y-axis plotter output connector to the Y-axis input connector on the plotter.

c. With no signal applied to the Y-axis, calibrate the X-axis of the plotter as described in Subparagraph 3.6.3.

d. Set the MODE Selector on the SD346 to OPER.

e. Move the cursor on the SD345 to the lower half of the "display cell" (discussed in Subpara graph 3.6.1) containing the desired harmonic order.

f. Set the analyzer controls so that the Y-axis output (at J4 on the SD345) corresponds to the contents of the data cell at the cursor location. (On the SD345, use the SPECT mode.)

g. Calibrate the Y-axis of the plotter as needed.

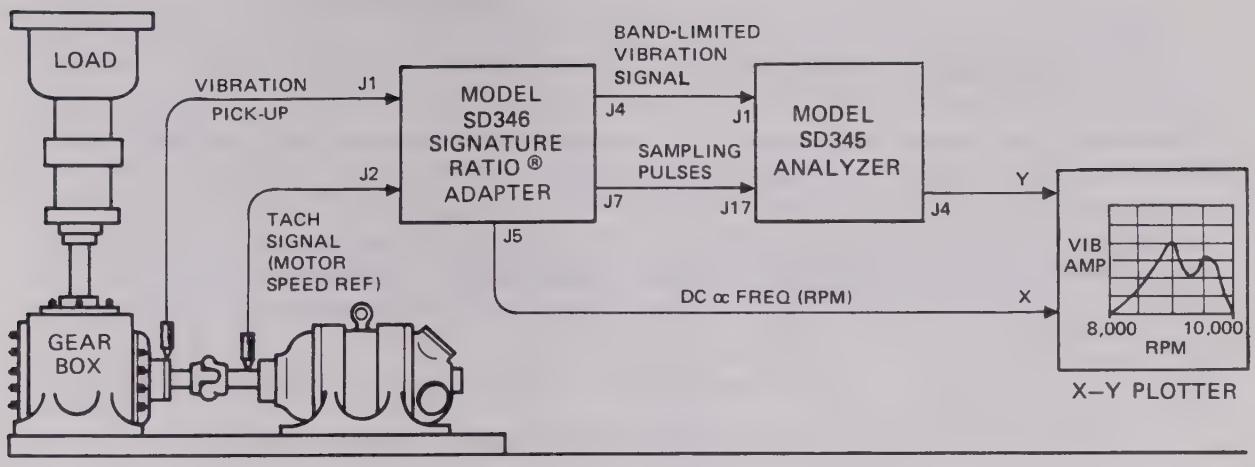


Figure 3-12. Setup for RPM Tracking with SD345

After you complete steps *a* through *g*, proceed with the RPM Tracking. As an example, suppose you want to plot the third harmonic order of the system shown in Figure 3-12. Assume that the SD345 displays the tenth order at full scale. Set the cursor to cell number 120 (400 × 3/10), and place the SD345 in the SPECT mode. Run the motor through its range of test speeds, and the plotter will plot the amplitude of the third order as a function of rpm. Figure 3-13 shows a typical result.

3.6.3 Plotter Calibration

When a plotter is used to record test results, its X-axis must be calibrated in terms of machine speed. This can be done by generating selected "tach frequencies" on the SD346 while using the DC ∝ RPM output to drive the X-axis of the plotter.

To calibrate the plotter, follow these steps:

a. Connect a coaxial cable from the SD346 DC ∝ RPM connector, J5, to the X-axis input connector on the plotter.

b. Establish an origin on the plotter, and adjust the X-axis sensitivity so that a 10 V input will produce a full-scale deflection.

c. Set the front-panel controls on the SD346 as follows:

   1. Set the MODE Selector to MAN. (In the MAN mode, the K Selector controls the frequency of an internally generated "tach" signal; the "tach frequency" is 100 × K.)

   2. Set the TACH FREQ RANGE Selector to the range that will be used during the test. (When the "tach frequency" equals the upper limit of this range, the deflection on the plotter will be full-scale; i.e., the output at J5 will be 10 V.)

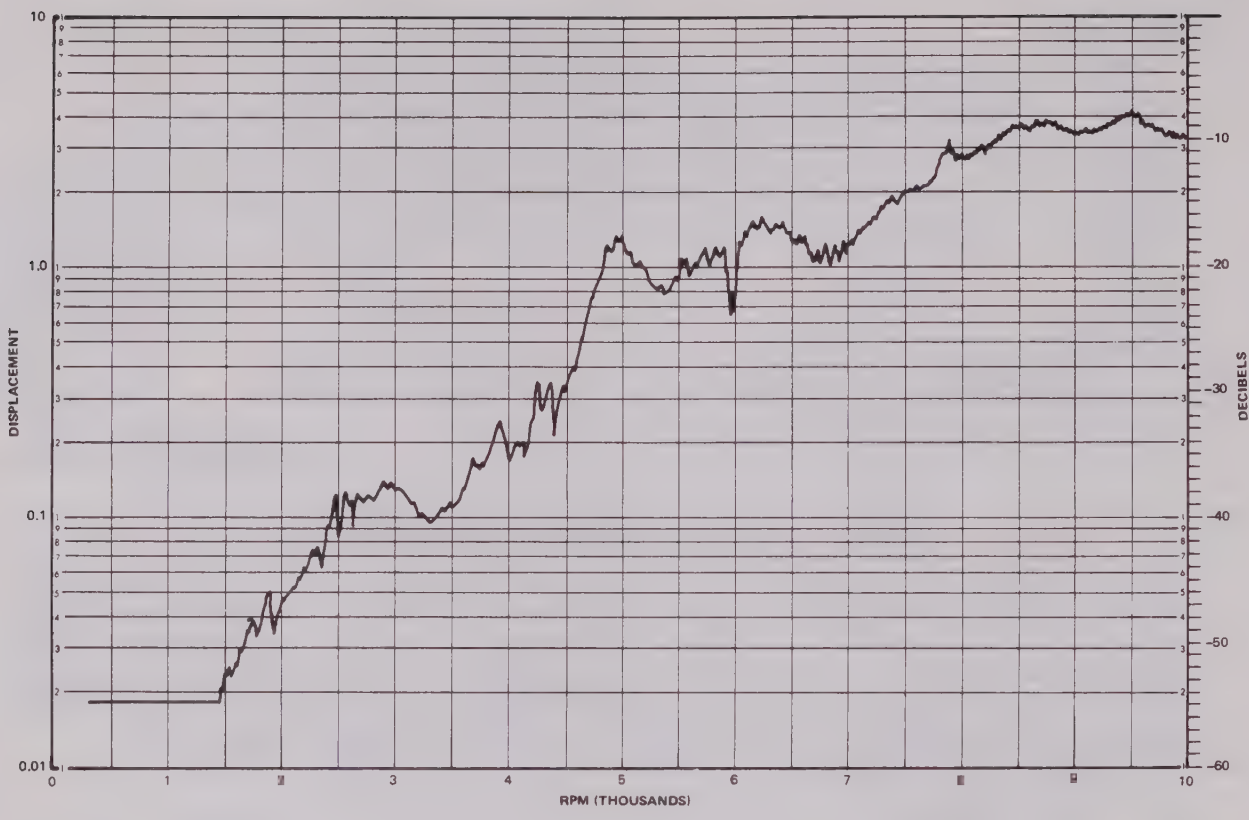


Figure 3-13. Typical Plot of Amplitude vs. RPM for a Single Harmonic Order

3. Set the K Selector according to the "tach frequency" you want to generate. (For example, to simulate a 200 Hz tach signal, set the K Selector to 002.) The plotter pen will move to the corresponding point on the X-axis.

d. To convert the K Selector setting to an equivalent machine speed, use the expression

$$\text{RPM} = \frac{6{,}000 \times K}{(P/R)} \quad .$$

Thus, if P/R = 4, a K Selector setting of 002 corresponds to a machine operating at

$$\text{RPM} = \frac{6{,}000 \times 2}{4} = 3{,}000 \text{ rpm} \quad .$$

e. Repeat steps *c3* and *d* until the X-axis of the plot has been calibrated.

For a given value of K, the deflection on the plotter depends upon the setting of the TACH FREQ RANGE Selector. If the 10 – 500 Hz range is used, for example, a 200 Hz "tach" signal will produce a 4 V output at J5, and the plotter pen will move to 2/5 of full scale.

3.6.4 Non-Standard Analysis Ranges

In the MAN mode, the SD346 does not track the TACH input frequency. Instead, fixed sampling and corner frequencies are chosen with the K Selector and the FILTER Range Selector. This feature is useful for synthesizing a frequency-analysis range that is tailored to a particular test. Consequently, you can vary the corner frequency of the low-pass filter in the SD346 from 100 Hz to 20 kHz in 100 Hz increments. (Actually, you can vary the full-scale analysis frequency from 100 Hz to 50 kHz in 100 Hz increments. However, for analysis ranges above 20 kHz, the FILTER Range Selector must be in the OUT position; this leaves only the aliasing filter in the analyzer for protection. Make sure the bandwidth of the analyzer aliasing filter is set appropriately.)

To establish a non-standard analysis range, follow these steps:

a. Set the MODE Selector on the SD346 to MAN.

b. Set the FILTER Range Selector to the lowest range that accommodates the desired analysis range.

c. Set the K Selector to establish the desired corner frequency for the low-pass filter. (In the MAN mode, $f_c = 100 \times K$.)

For example, suppose you want to examine vibration frequencies up to 15,000 Hz. The FILTER Range Selector should be set to 200 – 20K, and the K Selector should be set to 150. Then, the full-scale frequency on the display will be 15,000 Hz.

3.7 OPERATOR MAINTENANCE

The operator can check the performance of the Signature Ratio Adapter by following the procedures described in Paragraph 3.4, Operational Checkout. Maintenance by the operator should be limited to these procedures; only qualified service personnel should calibrate or service the instrument.

SECTION IV

THEORY OF OPERATION

4.1 INTRODUCTION

Every rotating machine has a unique vibration or acoustical pattern which is known as its signature. Even new machines of identical design will have slightly different signatures due to manufacturing tolerances. In addition, the signature of an individual machine will change as the machine ages in service. Consequently, the signature of a machine can be used to identify the amount and source of excessive vibration due to design or manufacturing imperfections, or excessive wear.

Ideally, the machine is operated at a fixed rpm, and the complex vibrations are measured by displacement, velocity, or acceleration sensors as the analyzer is automatically swept through a preselected frequency range, thus separating the individual vibration components. However, rpm will normally vary because of inherent speed-control limitations. If vibration amplitude is plotted against frequency, new calculations of vibration frequency divided by main-shaft frequency must be made continuously as rpm changes. The Signature Ratio method records data directly in vibration amplitude versus harmonic order (ratio of component speed to main-shaft speed). The relationships are automatically maintained on the plot or display regardless of rpm changes.

The SD346 provides Scientific-Atlanta analyzers with harmonic-order analysis capability. Alone, the analyzers provide frequency analyses on fixed ranges, determined by a fixed sampling frequency and fixed input filtering. With the Signature Ratio Adapter, the sampling frequency and input filtering can be varied automatically as the rotational speed changes. The SRA continuously updates both the sampling frequency (f_S) and the aliasing-filter corner frequency (f_c) as functions of the tachometer frequency (f_T). The controlled sampling rate causes the analyzer to track changes in rpm, and the dynamic low-pass filter maintains protection against aliasing terms. Hence, the analyzer produces a spectrum output that is a function of rotational order number rather than frequency.

4.2 SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

Refer to Figure 4-2, the Simplified Block Diagram, which folds out from the back of this section.

The vibration signal of interest is applied to the SRA DATA input connector, J1. With the MODE Selector in OPER or MAN, the signal proceeds to the attenuator section (not shown) of the Input Amplifier. The attenuator, controlled by the RANGE Data Input Attenuator, adjusts the amplitude of the input signal to the proper level. If the input voltage exceeds the selected full-scale value, the OVERLOAD indicator lights. After amplification, the vibration signal passes through the Dynamic Low-Pass Filter (described later).

The TACH input connector, J2, receives the output of the engine-mounted tachometer. Since the amplitude and shape of the tachometer pulses may vary, the signal is applied to the Tach Signal Conditioner. There, the tachometer pulses trigger a shaping circuit that produces fixed-amplitude, rectangular pulses at the tachometer frequency (f_T). Front-panel controls determine the voltage at which triggering occurs; proper triggering lights the TRIGGER indicator.

With the MODE Selector in OPER, the sampling frequency is derived from the tachometer frequency. The TACH FREQ RANGE/M Selector controls the Multiplier (M) Phase-Locked Loop, which multiplies the frequency of the conditioned signal by 6M. Frequency division by K follows in the programmable divider; the output of the divider (at a frequency of $6f_T \times M/K$) is sent to the Filter Control and to the Multiplier Section (described later).

With the MODE Selector in MAN, the tachometer frequency does not control the sampling frequency. Instead, the Synthesizer (K) Phase-Locked Loop produces a signal whose frequency is $600 \times K$. This signal goes to the Filter Control and to the Multiplier Section.

In the OPER mode, $f_c = f_T \times M/K$; in MAN, $f_c = 100 \times K$. Thus, the input to the Multiplier Section has a frequency of $6f_c$ in either mode. The Ratio Selector routes the signal through a series of frequency dividers, a frequency multiplier, and a multiplexer. The frequency $6f_c$ is multiplied and divided according to the sampling rate chosen, so that the output sampling frequency (f_S) is f_c times the sampling rate.

The Filter Control divides the frequency $6f_c$ according to the filter frequency range selected. A dc voltage proportional to the divided frequency is generated, and this voltage automatically varies the corner frequency of the Dynamic Low-Pass Filter.

4.3 DETAILED BLOCK DIAGRAM DESCRIPTION

Refer to sheet 1 of Figure 5-3, the Detailed Block Diagram, which folds out from the back of Section V.

4.3.1 Input

4.3.1.1 DATA Input

The vibration signal of interest is applied to the SRA DATA input connector, J1. The signal is ac coupled to the Input Amplifier, where the attenuator sets the proper operating level. (A steady, greater-than-full-scale signal causes the OVERLOAD indicator to light.) The signal is then routed through the Dynamic Low-Pass Filter (described later). When the MODE Selector is in OPER or MAN, the filtered signal is available at the DATA (FILTERED) output connector, J4. With the MODE Selector in BYPASS, or with the power off, the unfiltered vibration signal is applied directly to the DATA (FILTERED) output connector, completely bypassing the Adapter circuitry.

4.3.1.2 TACH Input

The TACH input connector, J2, receives the output of the engine-mounted tachometer and applies it to the conditioning circuitry, consisting of the AGC Amplifier, Peak Detector, and Comparator. The TACH SENSITIVITY Control and the Tach Waveform Selector determine the point on the tachometer waveform where the circuitry will trigger. Automatic gain control keeps the trigger point constant regardless of input-level fluctuations. If the tachometer signal is adequate, a properly chosen trigger level produces a pulse input to the One-Shot that lights the TRIGGER indicator with a steady glow.

4.3.2 Tachometer Signal Processor

OPER Mode

With the MODE Selector in OPER, the tachometer frequency regulates the sampling frequency. The conditioned signal (available at the TACH COND output connector, J3, in either the OPER or BYPASS mode) is applied to the multiplier (M) phase-locked loop, which consists of Phase Detector No. 1, the Loop Filter, VCO No. 1, and the $\div$ M and $\div$ 6 circuits. (M is determined by the TACH FREQ RANGE/M Selector.) The Phase Detector checks for a difference in frequency between the conditioned signal and the output of the loop dividers. Any difference is converted into an error signal (a series of positive or negative pulses) which is averaged to a dc signal by the Loop Filter. The dc signal controls the frequency of VCO No. 1, which produces the multiplier loop output. Since the output frequency of the loop is divided by 6M before being compared to the input frequency (f_T), the loop stabilizes (reaches a "no error" condition) when the frequency of VCO No. 1 is 6M $\times$ f_T.

In the OPER mode, the output of the phase-locked loop is applied to a programmable divider, where its frequency is divided by K. (K equals the setting on the front-panel K Selector.) The signal is unaffected by the 100 kHz Oscillator, Phase Detector No. 2, VCO No. 2, and the associated divider circuits. The output of the $\div$ K circuit goes to the Filter Section for filter control, and to the Multiplier Section for conversion to the desired sampling frequency.

MAN Mode

With the MODE Selector in MAN, the sampling frequency is not derived from the tachometer signal, but from the output of the synthesizer (K) phase-locked loop, which consists of Phase Detector No. 2, VCO No. 2, and the $\div$ 6 and programmable-divider circuits. The output of the 100 kHz Oscillator is divided down to 100 Hz, then applied to Phase Detector No. 2. The Phase Detector senses any difference in frequency between the 100 Hz signal and the output of the loop dividers. The resulting error signal controls the frequency of VCO No. 2, which generates the synthesizer loop output. Since the output frequency is divided by 6K before comparison to the 100 Hz signal, the loop stabilizes when the frequency of VCO No. 2 is 600 $\times$ K. The output of the synthesizer loop is sent to the Filter Section, and to the Multiplier Section.

In addition, the output of the synthesizer loop is fed to a divider circuit, where its frequency is divided by 6. The output of the divider circuit is routed to the TACH COND output connector, and to the multiplier (M) phase-locked loop, which is used only for the DC $\propto$ RPM output it provides. This feature makes the MAN mode useful for calibrating output recording instruments.

4.3.3 Multiplier

Refer to sheet 2 of Figure 5-3.

Recall that f_c is equal to f_T $\times$ M/K in the OPER mode, and equal to 100 $\times$ K in the MAN mode. In either case, the frequency of the input to the Multiplier Section is $6f_c$. Table 4-1 shows the sequence of operations required to produce each of the five available sampling rates.

Table 4-1. Sequence of Operations for Generating Sampling Rates

Initial Frequency	Sequence of Operations						Sampling Frequency
	#1	#2	#3	#4	#5	#6	
$6f_c$ →	÷ 6	÷ 5	× 256	÷ 5	÷ 2	÷ 2 →	2.56 f_c
$6f_c$ →	÷ 2 →						3.0 f_c
$6f_c$ →	÷ 5	÷ 5	× 256	÷ 5	÷ 2	÷ 2 →	3.072 f_c
$6f_c$ →	÷ 5	÷ 5	× 256	÷ 5	÷ 3 →		4.096 f_c
$6f_c$ →	÷ 6	÷ 5	× 256	÷ 5	÷ 2 →		5.12 f_c

Several circuits simultaneously receive the input to the Multiplier Section. The input to the Frequency-to-DC circuit is converted to a dc voltage proportional to $6f_c$. When this voltage is large enough (i.e., when $6f_c$ is high enough), it triggers the Comparator, whose role will be discussed later.

The Multiplier input is also applied to three divider circuits, where its frequency is divided respectively by 2, by 5, or by 6. Since the output of the ÷ 2 circuit gives a sampling rate of 3.0, it goes directly to the Multiplexer (described later). The outputs of the ÷ 5 and ÷ 6 circuits require further processing, so they are fed to a gating circuit. The setting of the Ratio Selector determines which of these signals is sent to the next divider for frequency division by 5.

The output of this divider (at TP1) is applied to the frequency-multiplier circuitry, which processes signals according to frequency. Low-frequency signals are processed, first by Phase-Locked Loop (PLL) No. 3 (consisting of Phase Detector No. 3, VCO No. 3, and Loop dividers), then by a ÷ 5 circuit. High-frequency signals are applied to a ÷ 5 circuit first, then transmitted to PLL No. 4 (composed of Phase Detector No. 4, VCO No. 4, and Loop dividers). The output of each set of circuits is sent to a gating circuit.

The input frequency (at TP1) is multiplied by 256 in PLL No. 3, then divided by 5 in the divider circuit. Also, the input frequency is divided by 5, then multiplied by 256 in PLL No. 4. However, when the frequency at TP1 is low, PLL No. 3 is operating within its designed frequency limits, while PLL No. 4 (operating at one-fifth the frequency of PLL No. 3) is below its lower limit. Therefore, the Comparator (which is in its untriggered state at low frequencies) sets the Gates to select the output of the low-frequency path for further processing. As the frequency at TP1 increases, PLL No. 3 will eventually exceed its upper limit. The PLLs are designed so that PLL No. 4 will be slightly above its lower limit when PLL No. 3 reaches its upper limit. At that point, the Frequency-to-DC output triggers the Comparator, setting the Gates to select the output of the high-frequency path. As the frequency is increased further, PLL No. 4 continues to operate within its normal range. The Comparator is set to trigger when $6f_c$ reaches approximately 50 kHz.

The output of the Gates is routed to a series of dividers that perform the final frequency divisions needed to produce the required sampling rates. The divider outputs are applied to the Multiplexer, where one of them (depending upon the setting of the Ratio Selector) is selected as the sampling signal. The sampling frequency is f_c times the setting of the Ratio Selector. In the OPER or MAN modes, the sampling signal is applied to the AUXILIARY FUNCTIONS connector, J7, pins 20 and 28. With the MODE Selector in BYPASS, the sampling output is disabled, and the internal/external sampling control outputs (J7, pins 2 and 7) are open.

4.3.4 Filter

Refer to sheet 1 of Figure 5-3.

As indicated earlier, a portion of the input to the Multiplier Section is routed to the Filter Section. This signal is applied to a series of frequency dividers, whose outputs are fed to a set of Gates. The setting of the FILTER Range Selector determines which signal appears at the output of the Gates.

The selected signal is applied to two Frequency-to-DC converters. One has a linear frequency-to-dc slope, and the other a stable dc output after maximum frequency is reached. The combination assures a linear ramp from 0.05 to 10 Vdc (at 3 kHz) and a stable 10 Vdc level at frequencies above 3 kHz at the output of the Larger-Than Gate, which is clamped to 10 V maximum. Below 0.05 V and above 10 V the LIMIT indicator lights, showing that the aliasing filter has stopped tracking. The FILTER meter reads either .5% or 100% at this time.

Figure 4-1 is a simplified circuit diagram of one stage (there are three) of the Dynamic Low-Pass Filter and Bandwidth Control circuits, illustrating the concept of operation. Note that lamp DS_a controls the resistance of the matched pair of photoconductors V_a and V_b. The resistance of V_a is forced to vary linearly with the dc voltage $\propto$ frequency, for if it does not, the output of operational amplifier A_a integrates toward or away from ground potential (depending upon the direction of the error); the lamp brightness increases or decreases and eventually is the proper level to cause the V_a resistance to equalize the currents at the summing junction. In the same manner, V_c is controlled by integrator A_c.

The photoconductors V_b and V_d are the resistive elements of the active filter; their photoresistive characteristics are matched to those of V_a and V_c respectively. Therefore, the resistive elements of the filter also track the dc $\propto$ frequency, so that the corner frequency tracks the TACH input frequency.

The three active stages comprise a 6-pole filter with all poles controlled as described. Thus, a very sharp cutoff occurs at the corner frequency, protecting against the appearance of aliasing terms in the analyzer output.

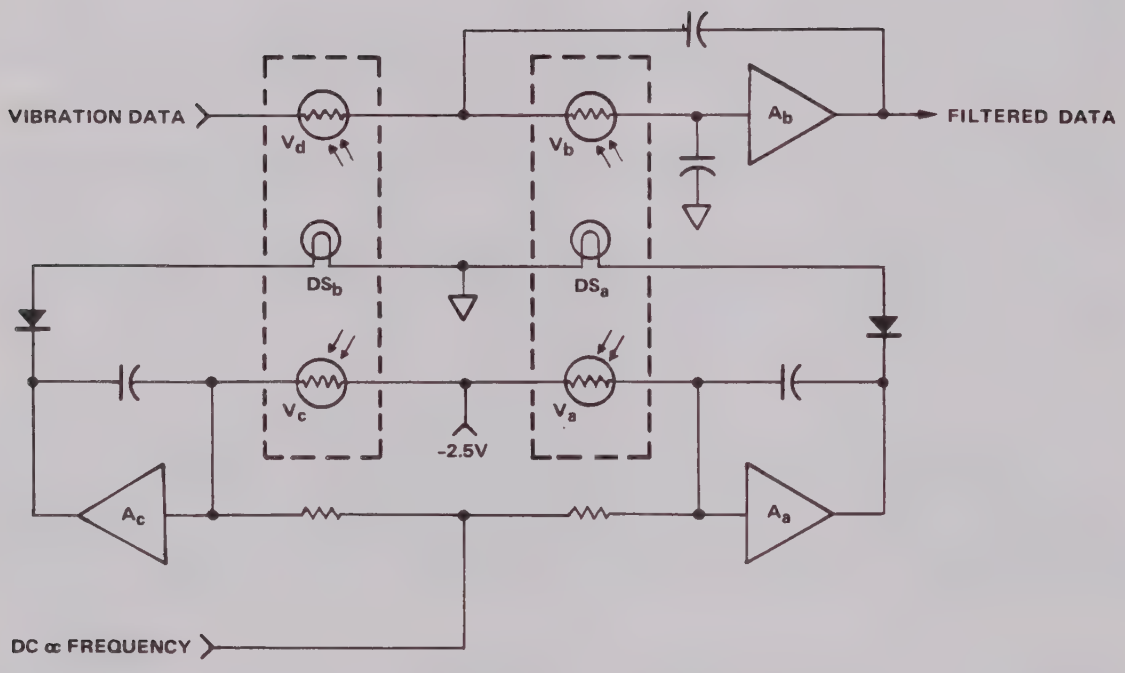


Figure 4-1. Simplified Circuit Diagram — Dynamic Low-Pass Filter

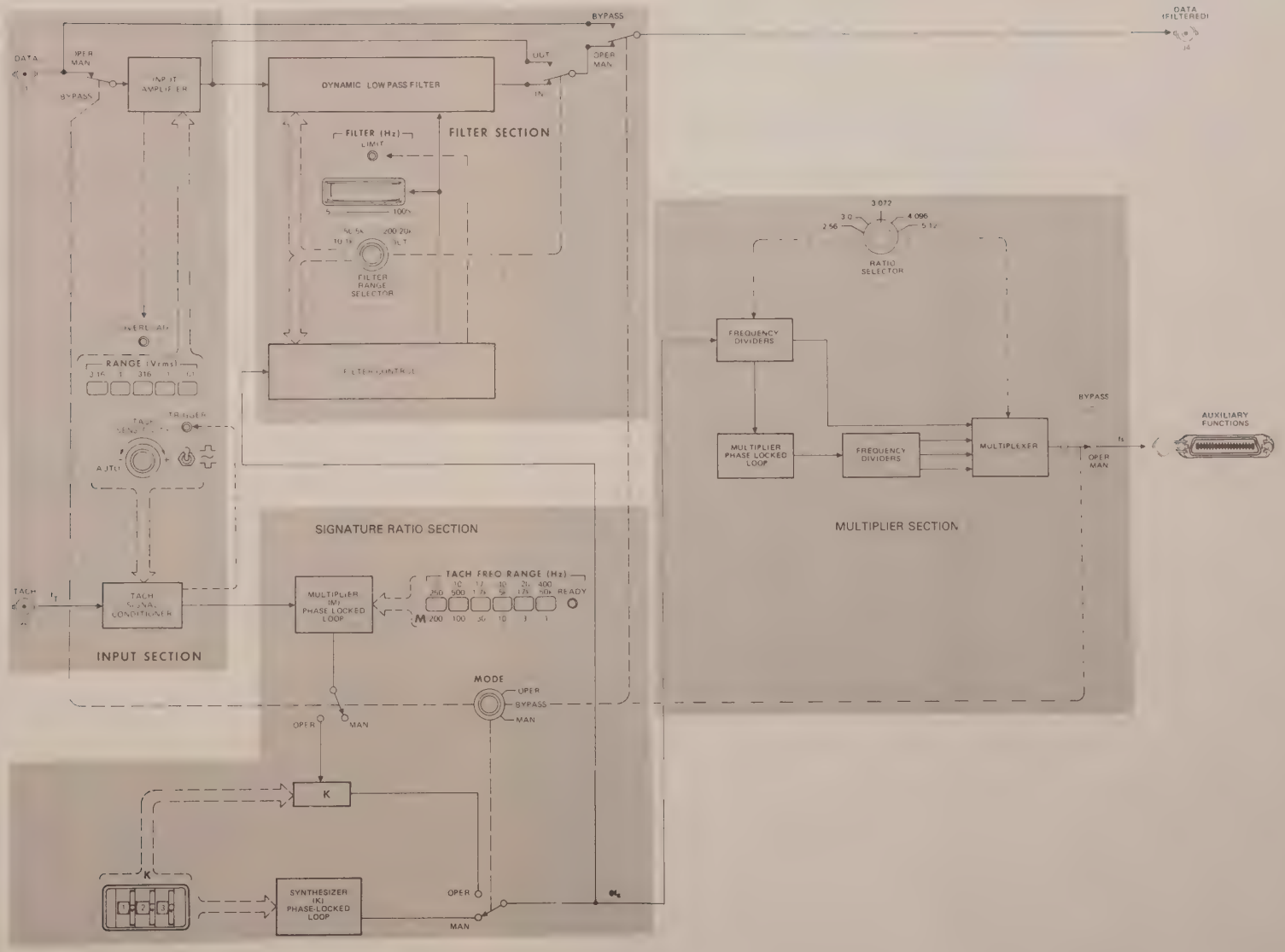


Figure 4-2. Simplified Block Diagram

SECTION V

CALIBRATION AND MAINTENANCE

5.1 INTRODUCTION

This section is written for the service technician. It contains a calibration procedure, block diagrams, and troubleshooting information. Schematic diagrams and other drawings are included at the back of the manual.

Study the preceding sections of this manual before you attempt to calibrate or service the Signature Ratio Adapter. Be sure you understand the functions of the front- and rear-panel controls, indicators, and connectors, as described in Paragraphs 3.2 and 3.3. You should also be thoroughly familiar with Section IV, Theory of Operation.

Figures 5-1 and 5-2 locate the internal controls used for calibrating the Model SD346. The Detailed Block Diagram, Figure 5-3, which folds out from the back of this section, shows the test points, waveforms, and controls used for calibration and troubleshooting.

Test points and components on circuit cards are identified by an alphanumeric code that specifies the circuit card and the test point or component. For example, resistor R6 on circuit card A2 is referred to as A2R6; test point number 17 on circuit card A1 is denoted by A1TP17. The letter *E* denotes a terminal on a circuit card; the symbol *-E* is used if the terminal connects to a component mounted on the chassis. For example, A2E14 and A2E15 are linked by a jumper wire on circuit card A2, while A2-E3 is connected to the DATA (FILTERED) connector, J4. Multipin connectors are designated by a *P*, as in A3P1-7.

5.2 CALIBRATION

The calibration procedure for the Model SD346 is described in the following paragraphs. To ensure proper calibration, perform the procedure in its entirety, and perform all steps in the order given. Refer to Figures 5-1, 5-2, and 5-3 as needed.

5.2.1 Equipment Needed

To calibrate your SD346, you will need the test equipment shown in Table 5-1; instruments having equal or better operating characteristics may be substituted.

5.2.2 Getting Ready

WARNING

High voltages are present inside this instrument whenever the power cord is connected, even when the POWER switch is off. Observe all normal safety precautions to avoid electrical shock.

a. Remove the top and bottom covers of the instrument. To remove each cover, (1) remove the screws securing the cover, then (2) slide the cover out toward the rear of the instrument.

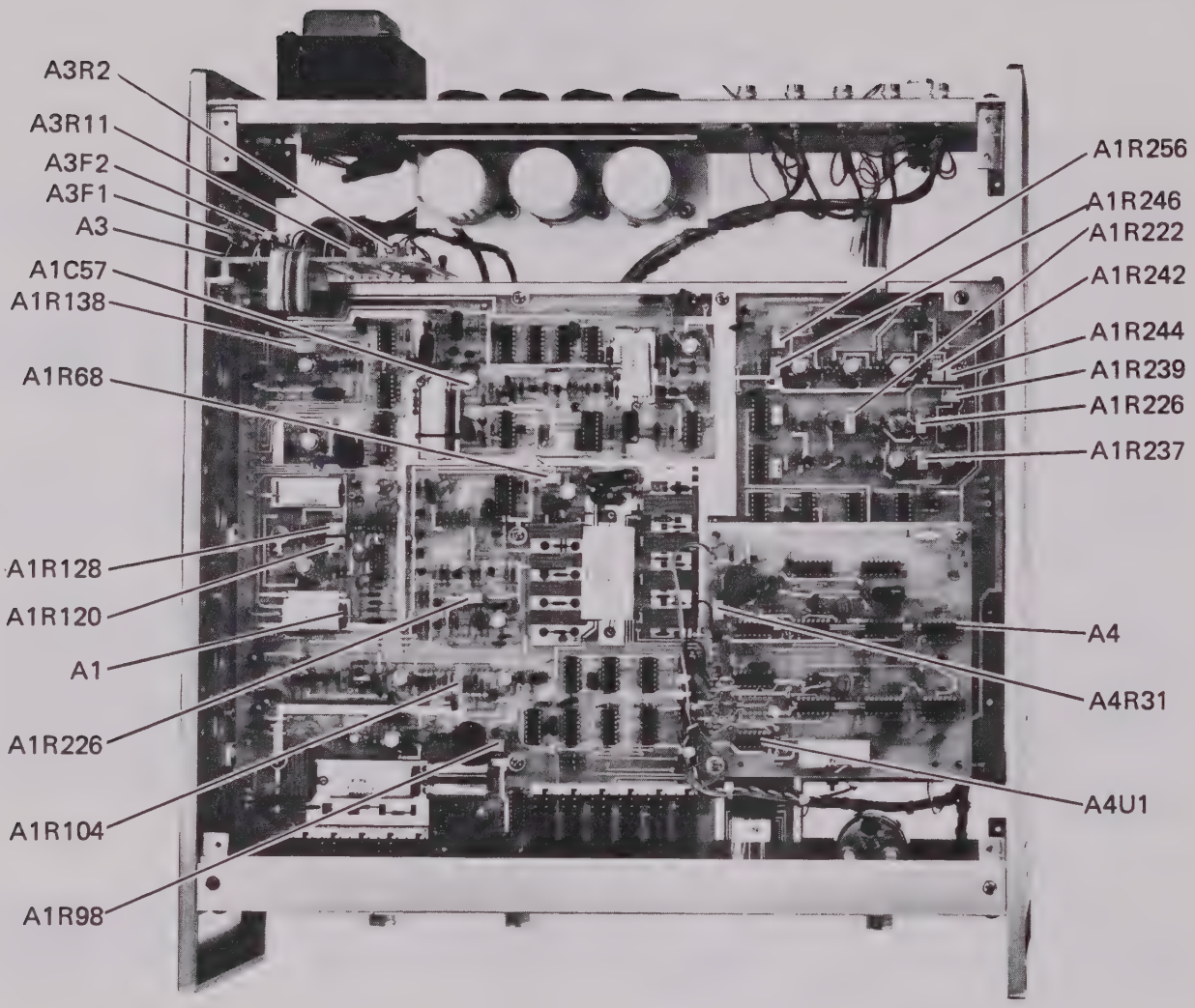


Figure 5-1. Top View of Chassis

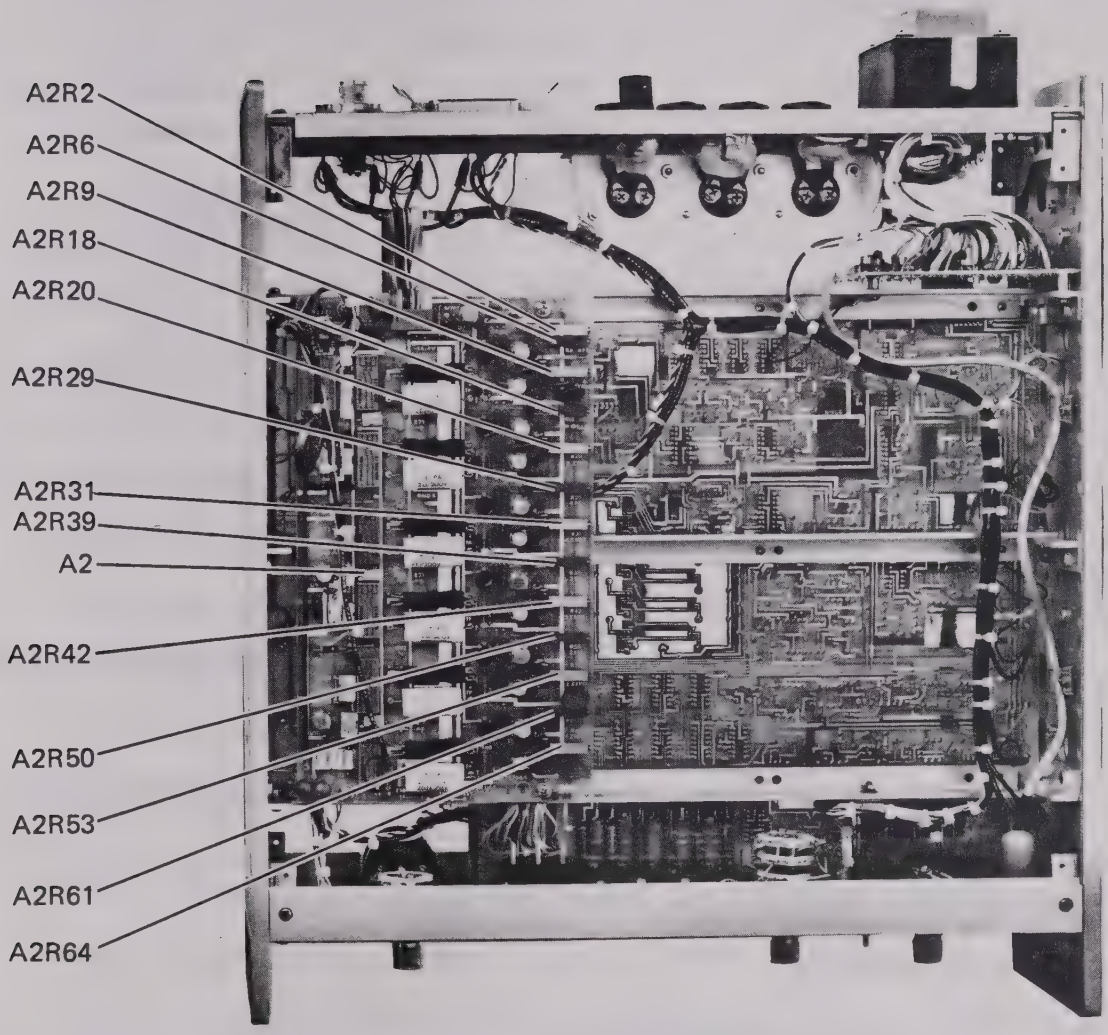


Figure 5-2. Bottom View of Chassis

Table 5-1. Instruments Needed for Calibration

Instrument	Model No.	Manufacturer
Oscilloscope	561 or 7403N	Tektronix
Sweep Oscillator	SD104A-5	Scientific-Atlanta
Digital Voltmeter	3440A or DS 100	Hewlett-Packard Doric
RMS Voltmeter	3400	Hewlett-Packard
Frequency Counter	5223L	Hewlett-Packard
Pulse Generator	115	Tektronix
Digital Ohmmeter	3440A with 3444A plug-in	Hewlett-Packard

b. Apply power to the SD346 and to the test instruments. Let them warm up for about fifteen minutes before you proceed.

5.2.3 Power Supply Circuit Card (A3)

a. Connect the digital voltmeter to A3TP2; adjust A3R11 for a reading of -15 ± 0.05 Vdc.

b. Connect the DVM to A3TP1; adjust A3R2 for $+15 \pm 0.05$ Vdc.

c. The voltage at A3TP5 should be $+1 \pm 0.5$ Vdc. If it is not, select a new value for A3R7 such that the voltage is within the prescribed limits.

5.2.4 VCO Circuit Card (A1)

5.2.4.1 Tach Conditioner

a. Set the following controls as shown:

MODE Selector	–	OPER
M Selector	–	10
TACH SENSITIVITY Control	–	AUTO
Tach Waveform Selector	–	~

b. Short the TACH connector, J2. Connect the oscilloscope to A1TP12. Adjust A1R128 (BAL) for 0 ± 100 mVdc at A1TP12. Remove the short at J2.

c. Apply a 100 ± 5 mVrms, 1000 Hz sine wave to J2. Adjust A1R120 (AMPL) so that the positive peak of the waveform at A1TP12 is 4 ± 0.3 V.

d. Set the Tach Waveform Selector to⎍. Connect the pulse generator to J2, and apply a 1000 Hz signal having an amplitude of +1 ± 0.1 V, with a duty cycle of approximately 10%. Measure the peak pulse height at A1TP12. Adjust A1R138 (PEAK) so that the dc voltage at A1TP14 is approximately 2/3 of the peak pulse height at A1TP12.

5.2.4.2 VCO No. 2

a. Set the following controls as shown:

MODE Selector	–	MAN
Ratio Selector	–	3.072

b. Connect the frequency counter to A1TP17. Adjust A1C57 for 100,000 ± 2 Hz at A1TP17.

5.2.4.3 Bandwidth Control

a. Set the FILTER Range Selector to 200 – 20K.

b. Set the K Selector to 200. Adjust A1R222 (F.S.) for +10 ± 0.1 Vdc at A1TP27.

c. Set the K Selector to 002. Adjust A1R226 (ZERO) for +100 ± 1 mVdc at A1TP27.

d. Repeat steps *b* and *c* until both conditions are satisfied.

e. Set the K Selector to 267. Adjust A1R237 (F.S.) for +10 ± 0.1 Vdc at A1TP26.

f. Set the K Selector to 002. Adjust A1R239 (ZERO) for +100 ± 1 mVdc at A1TP28.

g. Set the K Selector to 220. Adjust A1R246 (10V) for +10 ± 0.1 Vdc at A1TP30.

h. Set the K Selector to 002. Momentarily short A1TP28 to ground. Adjust A1R256 (.05V) for +50 ± 0.5 mVdc at A1TP30. Remove the short from A1TP28.

i. Adjust A1R242 (ZERO) for +100 ± 1 mVdc at A1TP30.

j. Set the K Selector to 200. The voltage at A1TP30 should be +10 ± 0.1 Vdc. Adjust A1R244 (METER) for full-scale deflection on the FILTER meter.

k. Set the K Selector to 001. The FILTER meter should read .5%, and the LIMIT indicator should flicker on and off. If it does not flicker, repeat steps *b* through *j*.

l. Sequentially set the K Selector to each value from 195 to 203. The LIMIT indicator should light between K = 198 and K = 202; the FILTER meter should read full scale. If the LIMIT indicator does not light, repeat steps *b* through *j*.

5.2.4.4 VCO No. 1

a. Set the following controls as shown:

MODE Selector	–	OPER
M Selector	–	200

b. Connect the constant-amplitude-square-wave output from the SD104A-5 to J2. Set the MULT (A) switch on the SD104A-5 to .001, and set the frequency of the square wave to 5 ± 0.05 Hz (period of 200 ± 2 ms).

c. Adjust A1R266 for 0 ± 1 mVdc at A1TP7.

d. Adjust A1R68 (PHASE) for minimum error-pulse width at A1TP7; this should correspond to minimum frequency jitter at A1TP6. The frequency at A1TP6 should be 6,000 ± 60 Hz.

e. Set the M Selector to 1. Set the frequency of the SD104A-5 to 50,000 ± 500 Hz. Adjust A1R98 for + 10 ± 0.1 Vdc at A1TP5.

f. Set the frequency of the SD104A-5 to 500 ± 5 Hz. Adjust A1R104 for + 100 ± 1 mVdc at A1TP5.

g. Repeat steps *e* and *f* until both conditions are satisfied.

5.2.5 Filter Circuit Card (A2)

NOTE

Do not attempt to calibrate the filter unless a photo cell or related component has been replaced and/or the instrument fails the test described in Subparagraph 3.4.9.

a. Disconnect the inputs at J1 and J2. Turn off the power to the SD346.

b. Disconnect one end of each of the following jumper wires: A2E16 to A2E17, A2E18 to A2E19, and A2E22 to A2E23.

c. Reapply power to the SD346.

d. Set the MODE Selector to BYPASS.

e. Connect the digital voltmeter to A2TP7, and adjust A2R2 (REF) for a reading of − 3 ± 0.03 Vdc.

f. Set the following controls as shown:

MODE Selector	–	MAN
FILTER Range Selector	–	200 – 20K

g. Set the K Selector to 200. Check at A1TP30 for + 10 ± 0.1 Vdc. If the voltage is not within tolerance, repeat the adjustments in Subparagraph 5.2.4.3, Bandwidth Control.

h. Set the K Selector to 002. Check at A1TP30 for + 100 ± 1 mVdc. If the voltage is not within tolerance, repeat the adjustments in Subparagraph 5.2.4.3, Bandwidth Control.

i. Connect the digital ohmmeter to each pair of points listed in the table below, and set the K Selector as shown. For each setting, adjust the indicated potentiometer (loosen beeswax if necessary) to obtain the ohmmeter reading shown. Repeat all adjustments until there is no interaction.

Ohmmeter Connection	K	Potentiometer Adjustment	Ohmmeter Reading
A2E15 to A2E16	200 002	A2R61 (1 FS) A2R64 (1 ZERO)	2.8 ± 0.02 kΩ 280 ± 4 kΩ
A2E17 to A2TP12	200 002	A2R50 (2 FS) A2R53 (2 ZERO)	2.8 ± 0.02 kΩ 280 ± 4 kΩ
A2E19 to A2E20	200 002	A2R39 (3 FS) A2R42 (3 ZERO)	2.8 ± 0.02 kΩ 280 ± 4 kΩ
A2E21 to A2TP11	200 002	A2R29 (4 FS) A2R31 (4 ZERO)	2.8 ± 0.02 kΩ 280 ± 4 kΩ
A2E23 to A2E24	200 002	A2R18 (5 FS) A2R20 (5 ZERO)	2.8 ± 0.02 kΩ 280 ± 4 kΩ
A2E25 to A2TP10	200 002	A2R6 (6 FS) A2R9 (6 ZERO)	2.8 ± 0.02 kΩ 280 ± 4 kΩ

j. Turn off the power to the SD346. Resolder all the jumper wires on A2. Reseal all potentiometers on A2 with beeswax.

k. Reapply power to the SD346.

5.2.6 Multiplier Circuit Card (A4)

a. Set the following controls as shown:

MODE Selector	–	OPER
RANGE Attenuator	–	.1
TACH FREQ RANGE Selector	–	10 – 500
TACH SENSITIVITY Control	–	AUTO
K Selector	–	003
FILTER Range Selector	–	200 – 20K
Ratio Selector	–	3.072

b. Apply a 100 ± 5 mVrms sine wave at approximately 200 Hz to both J1 and J2.

c. Connect the oscilloscope to A4U3, pin 7.

d. Connect the frequency counter to A4U13, pin 14.

e. Set the frequency of the signal at J1/J2 so that the counter indicates 40 kHz. Wait for the READY indicator to light.

f. Slowly increase, then decrease the frequency at J1/J2 so that the counter reading ranges from 40 kHz to 60 kHz and back. Adjust A4R31 (FUNCTION CROSSOVER) so that the voltage monitored on the oscilloscope goes high (≈ 5V) when the frequency counter indicates between 50 and 60 kHz, and goes low when the counter indicates between 40 and 50 kHz. Make sure the READY indicator remains lit during this adjustment.

5.2.7 Performance Check

The calibration of your SD346 is now complete. To confirm that the instrument is operating properly, perform the operational checkout described in Paragraph 3.4.

5.3 MAINTENANCE

5.3.1 Operational Checkout

The operational checkout described in Paragraph 3.4 is an excellent tool for locating malfunctions or for determining whether the instrument needs calibrating.

5.3.2 Troubleshooting

If your SD346 fails to operate properly and you cannot determine the cause of the failure, call your Scientific-Atlanta representative for assistance. Our Customer Service technicians are always happy to help you, and they can solve many problems by telephone. They can serve you most effectively if you follow the guidelines below.

Before You Call

You may be able to locate the source of the problem by performing these simple checks:

a. Carefully check all connectors, plugs, and cables. Loose connections or defective cables, rather than an instrument malfunction, may be causing the problem.

b. Carefully check all front- and rear-panel control settings and indicators. Incorrectly adjusted controls can make a properly functioning instrument appear defective.

If the preceding checks do not reveal the cause of the failure, complete the following steps before you call:

a. Write down the significant details of the problem (e.g., symptoms you observed, control settings on the SD346 and associated instruments when the problem occurred, etc.).

b. Perform the *entire* operational checkout described in Paragraph 3.4, and write down the details of any test that the instrument fails (include control settings, voltages, frequencies, etc.).

c. Have your written records of symptoms and test failures handy when you call; our technicians will need this information.

d. If possible, use a telephone near your service bench; if more tests are needed, our technicians can guide you by telephone while you perform the tests.

Following Up

When you call for assistance, our Customer Service technicians may suggest additional tests or servicing procedures to help you locate and correct the problem. Be sure you thoroughly understand Section IV, Theory of Operation, before you attempt to service your SD346. While troubleshooting, refer to Figure 5-3, the Detailed Block Diagram, which folds out from the back of this section, and to the schematic diagrams at the back of the manual. The Detailed Block Diagram shows key test points with typical readings; the readings are valid for the control settings shown. Test points used in the calibration procedure are shown in black, while the remaining ones are white. The Detailed Block Diagram also identifies the calibration controls to help you troubleshoot problems encountered during calibration. However, the calibration controls should not be adjusted for troubleshooting purposes unless a full calibration follows.

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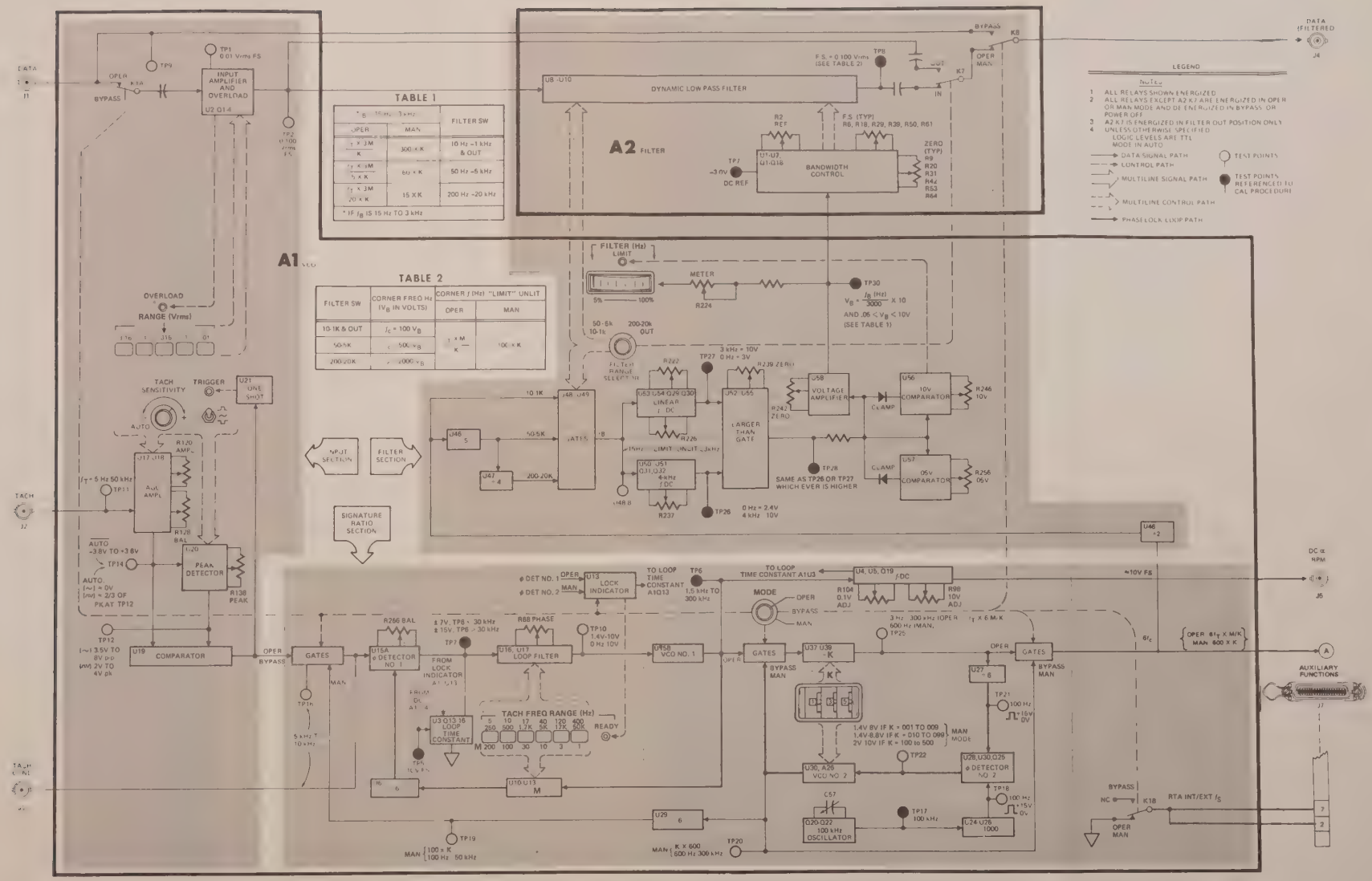


Figure 5-3. Detailed Block Diagram (Sheet 1 of 2)

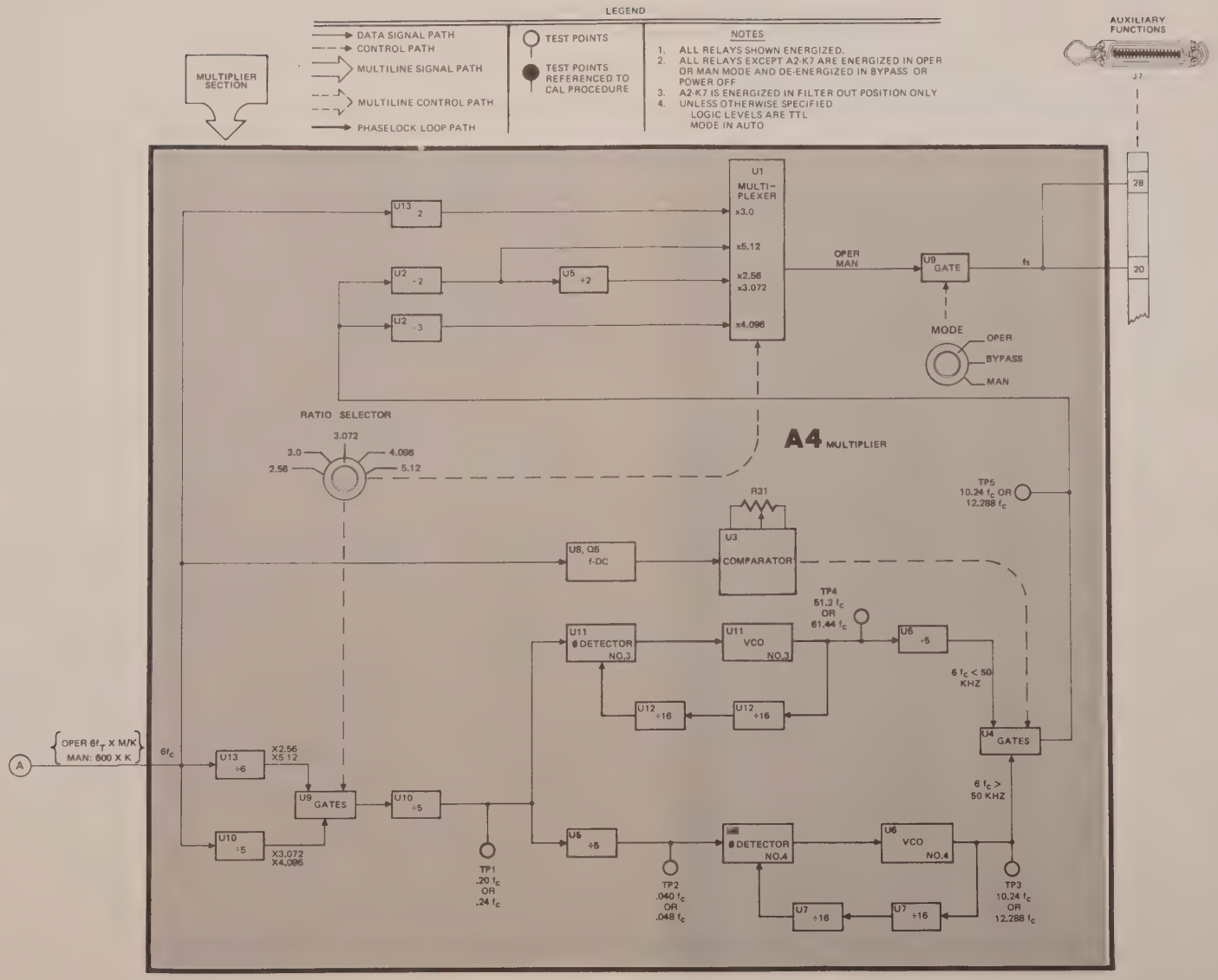


Figure 5-3. Detailed Block Diagram (Sheet 2 of 2)

SECTION VI

REPLACEMENT PARTS

Except for some special Scientific-Atlanta specification-controlled parts listed in Tables 6-1 through 6-7, which must be ordered from Scientific-Atlanta, Inc., Spectral Dynamics Division, standard electronic parts have been used throughout the Model SD346. Some miscellaneous standard parts have been included in the tables to aid in obtaining replacements. Spectral Dynamics Division maintains a complete stock of all parts and printed circuit assemblies used in the SD346.

When ordering a replacement part or assembly, be sure to include the reference designator (if applicable), the part number, and a complete description; also include the instrument name, model number, and serial number. For parts located on printed circuit assemblies, include the assembly part number.

Table 6-1. Special Replaceable Parts List: Wiring Assemblies

Reference Designator	Description	Part No.
A1	Main Frame Assembly	21189000
A1A1	VCO Circuit Card Assembly	21235200
A1A2	Filter Circuit Card Assembly	10072800
A1A3	Power Supply Circuit Card Assembly	10071800
A1A4	Multiplier Circuit Card Assembly	21185600
A2	Front Panel Assembly	21183200
A3	Rear Panel Assembly	21182000

Table 6-2. Special Replaceable Parts List: Controls and Switches

Reference Designator	Description	Part No.
A1A1K1-5	Relay; Electrol Part No. RA30552121	10601802
A1A1K6-9	Relay; Electrol Part No. RA30551121	10601801
A1A1S1	Switch (RANGE Data Input Attenuator)	21339700
A1A1S2	Switch (TACH FREQ RANGE/M Selector)	10076400
A1A2K1-6	Relay; Electrol Part No. RA30552121	10601802
A1A2K7, 8	Relay; Electrol Part No. RA30571121	10601800
A2S1/R1	Switch/Pot Assembly (TACH SENSITIVITY Control)	01449701
A2S2	Switch (Tach Waveform Selector)	10095300
A2S3	Switch Assembly (MODE Selector)	21191200
A2S4	Switch Assembly (K Selector)	10090600
A2S5	Switch Assembly (FILTER Range Selector)	10083200
A2S6	Switch (POWER); Marco-Oak Part No. 616-6-1	10529000
A3S7	Switch (Line Voltage); Switchcraft Part No. 46256LFR	10528600
A3S8	Switch (Ratio Selector)	21191100

Table 6-3. Special Replaceable Parts List: Indicators

Reference Designator	Description	Part No.
A2DS1-4	Lamp, LED (front-panel indicators); Monsanto Part No. MV5025	10535601
A2DS5	Lamp, Neon (POWER indicator); General Electric Part No. A1H	10538300
A2M1	Meter (FILTER meter)	21345700

Table 6-4. Special Replaceable Parts List: Connectors

Reference Designator	Description	Part No.
A1P7	Connector; Amphenol Part No. 57-30362	10574405
A3J1-5	Connector (DATA and TACH inputs, and TACH COND, DATA (FILTERED), and DC ∝ RPM outputs); Bendix Dage Part No. 667-6	10546500
A3J6	Connector (POWER input); Switchcraft Part No. AC3G	10546400
A3J7	Connector (AUXILIARY FUNCTIONS output); Amphenol Part No. 57-40362	10554902
A3XF1	FUSE Holder (rear-panel); Littelfuse Part No. 342004A	10534500

Table 6-5. Special Replaceable Parts List: Integrated Circuits

Reference Designator	Description	Part No.
A1A1U15,30	IC (phase-locked loop); Motorola Part No. MC14046BCP	10597700
A1A4U6,11	IC (phase-locked loop); Motorola Part No. MC14046BCP	10597700

Table 6-6. Special Replaceable Parts List: Miscellaneous Electrical Parts

Reference Designator	Description	Part No.
A1A1Y1	Crystal, 100 kHz; CTS Knight Part No. 018-0004	21320400
A1A2A1-6	Photo-Cell Assembly	01279001
A3T1	Power Transformer	10057800

Table 6-7. Special Replaceable Parts List: Mechanical Parts

Description	Part No.
Front Panel	21234843
Rear Panel	21181901
Top Cover	21182600
Bottom Cover	21393300
Filler Cover	21103500
Side Cover	21392400
Knob (for MODE Selector, FILTER Range Selector, Ratio Selector, and TACH SENSITIVITY Control)	21317500
Knob, White (for TACH FREQ RANGE/M Selector and RANGE Data Input Attenuator)	21336004
Rubber Strap (for 100-kHz crystal and for tie-down); Rubber Teck Part No. 2829-75-2	10586601
Power Cord; Belden Part No. 17952	10546200
Rack-Mounting Brackets	21145600
Accessory Kit	21194700
Instruction Manual	21240900
Wire List	21189000

APPENDIX A

INTERCONNECTION DIAGRAMS

This appendix contains diagrams for connecting the SD346 to other Scientific-Atlanta instruments. It also provides construction details of the cable assemblies used. The functional description of the SD346 AUXILIARY FUNCTIONS connector, J7, is reproduced here for your convenience.

Table A-1. List of Interconnecting Cables and Interconnection Diagrams

Instrument(s) Connected to SD346	Cable Assembly Number	Figure
Model 13180-20	10079500	A-1
SD210 or SD210A	21189700	A-2
SD301 Series	10079400	A-3
SD301 Series/SD309	10084700	A-4
SD330	10079500	A-1
SD330A	10079500	A-5
SD335	10079500	A-5
SD340-33	10480100	A-6
SD345	21187900	A-7
SD345 (Zoom)	21282400	A-8
SD360	10468600	A-9
SD375	21369800	A-10
SD375/SD420	21381200	A-11

Table A-2. AUXILIARY FUNCTIONS Connector (J7) Functional Description

Pin	Function	Ratio Selector	Scientific-Atlanta Analyzers Used With	Mode	Signal
1	GND				
2 & 7	SAMPLE FREQ CONTROL			OPER MAN BYPASS	GND GND OPEN
9 & 10	GND				
19	GND				
20	f_s	2.56	SD340-33 SD210 or SD210A	OPER MAN	$f_t \times \frac{2.56M}{K}$ 256 × K
		3.0	SD301 Series SD330 Series Model 13180-20	OPER MAN	$f_t \times \frac{3.0M}{K}$ 300 × K
&		3.072	SD335	OPER MAN	$f_t \times \frac{3.072M}{K}$ 307.2 × K
		4.096	SD360	OPER MAN	$f_t \times \frac{4.096M}{K}$ 409.6 × K
28		5.12	SD345 SD375	OPER MAN	$f_t \times \frac{5.12M}{K}$ 512 × K

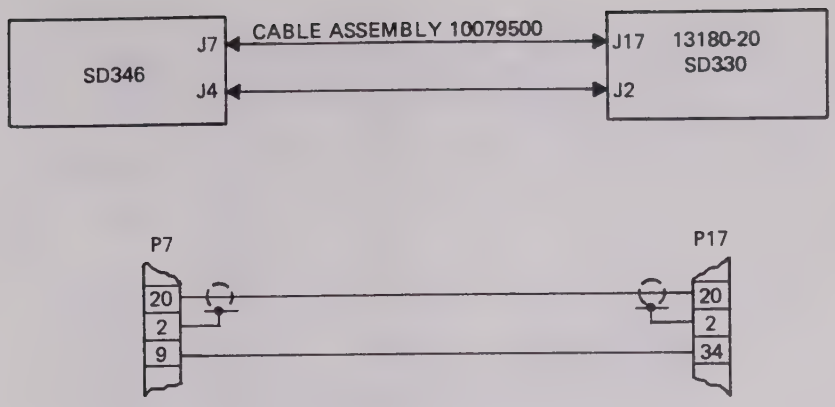


Figure A-1. Interconnection Diagram for SD346/SD330 or 13180-20

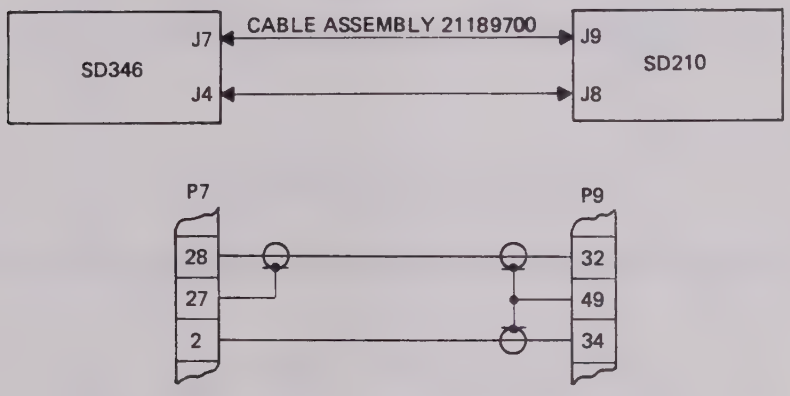


Figure A-2. Interconnection Diagram for SD346/SD210 or SD210A

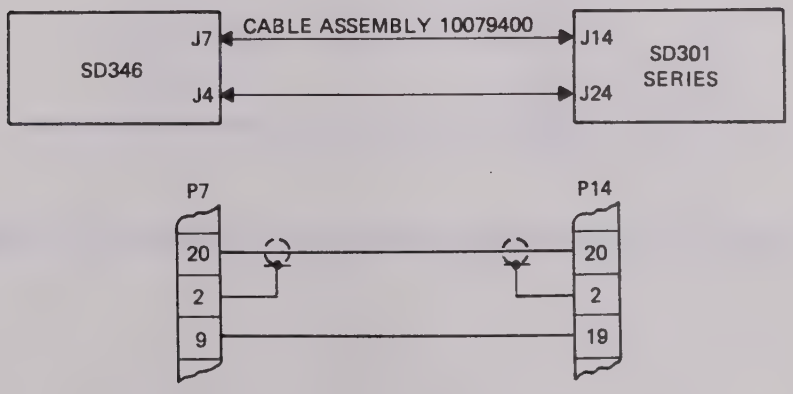


Figure A-3. Interconnection Diagram for SD346/SD301 Series

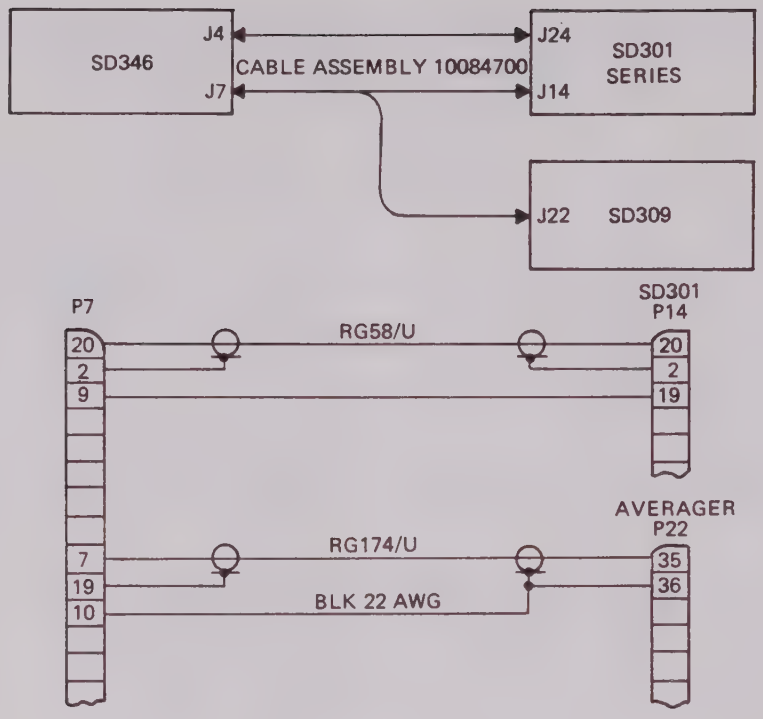


Figure A-4. Interconnection Diagram for SD346/SD301 Series/SD309

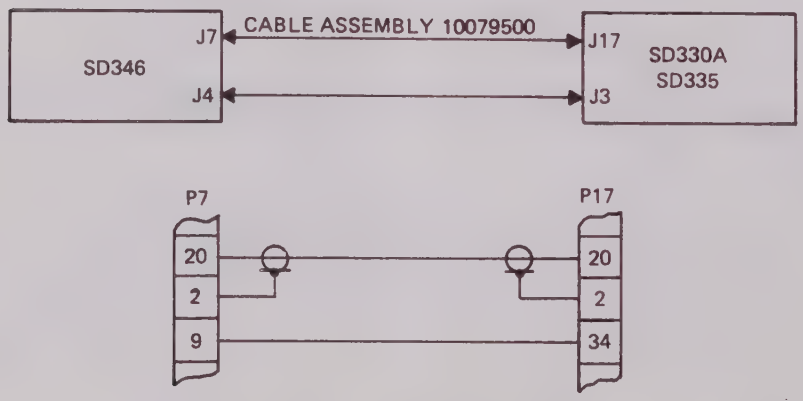


Figure A-5. Interconnection Diagram for SD346/SD335 or SD330A

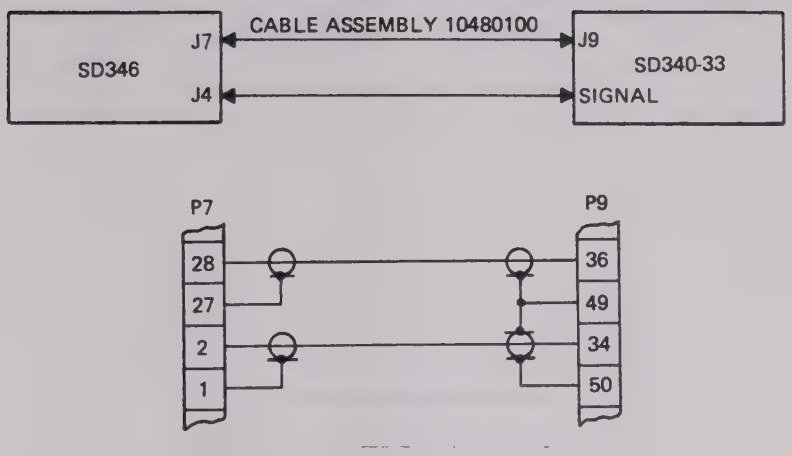


Figure A-6. Interconnection Diagram for SD346/SD340-33

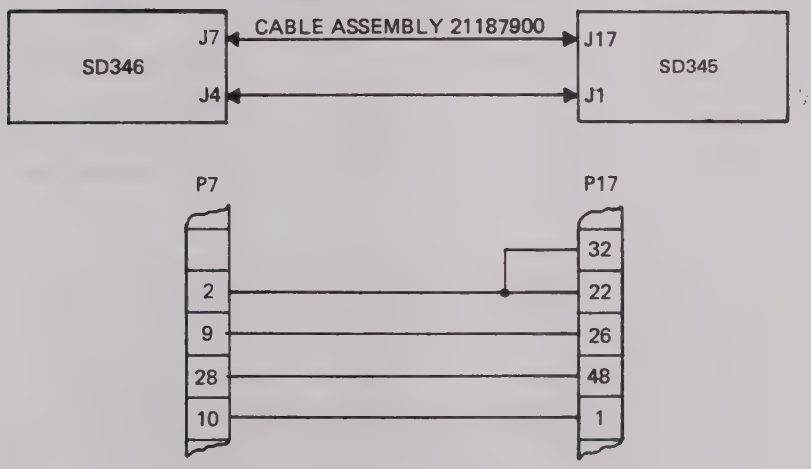


Figure A-7. Interconnection Diagram for SD346/SD345

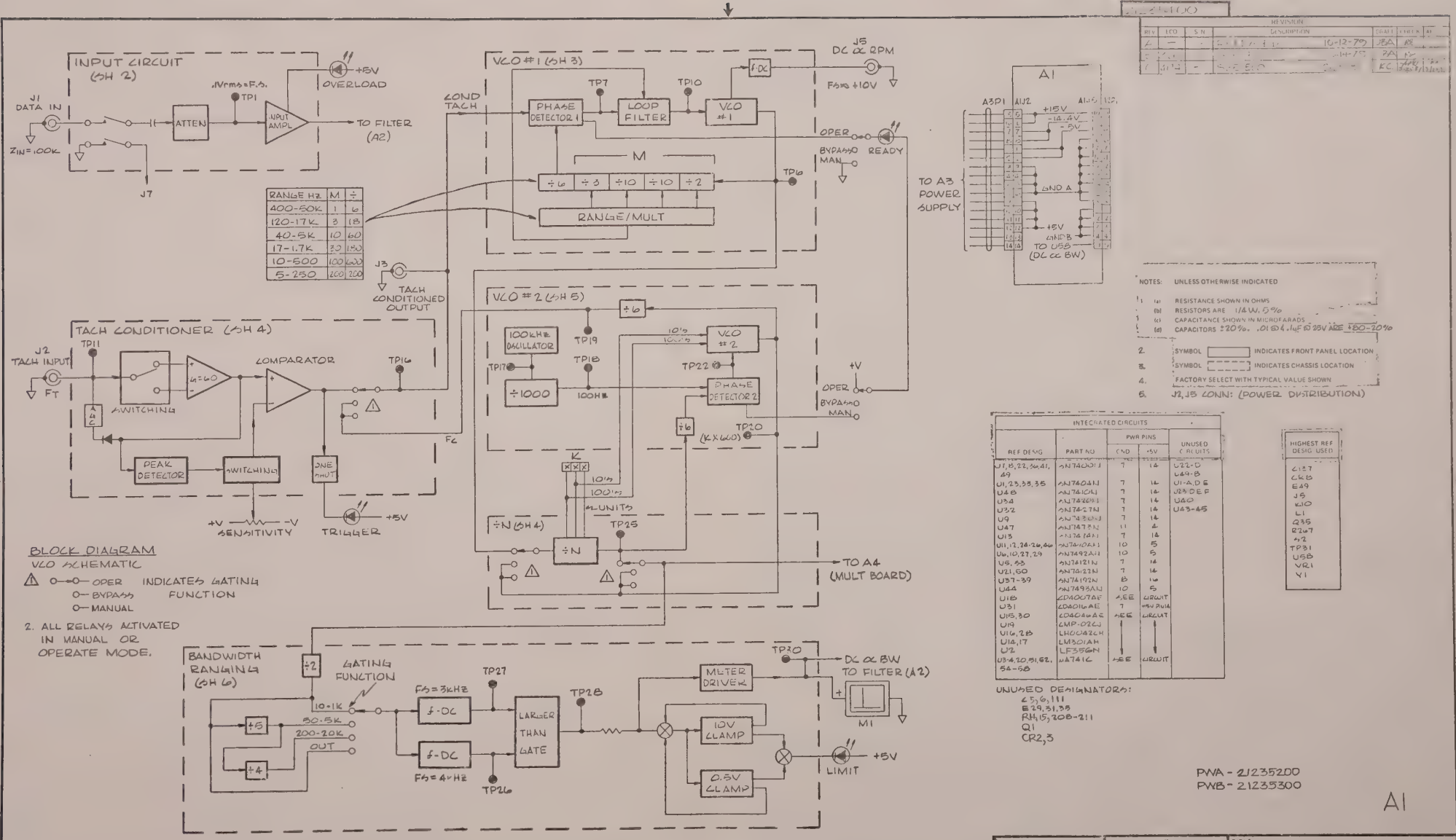
APPENDIX B

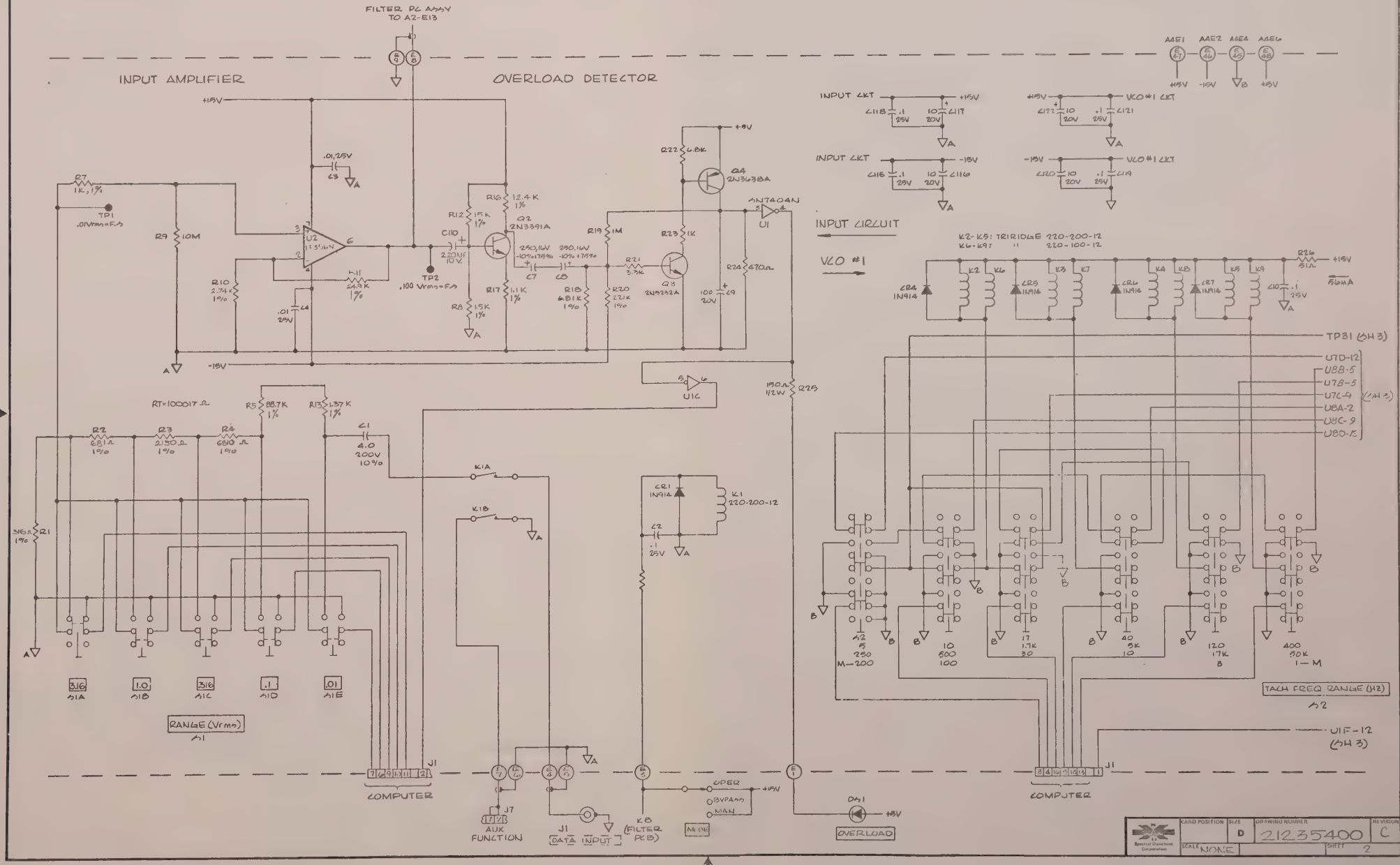
SCHEMATIC DRAWINGS

The set of drawings listed below begins on the next page.

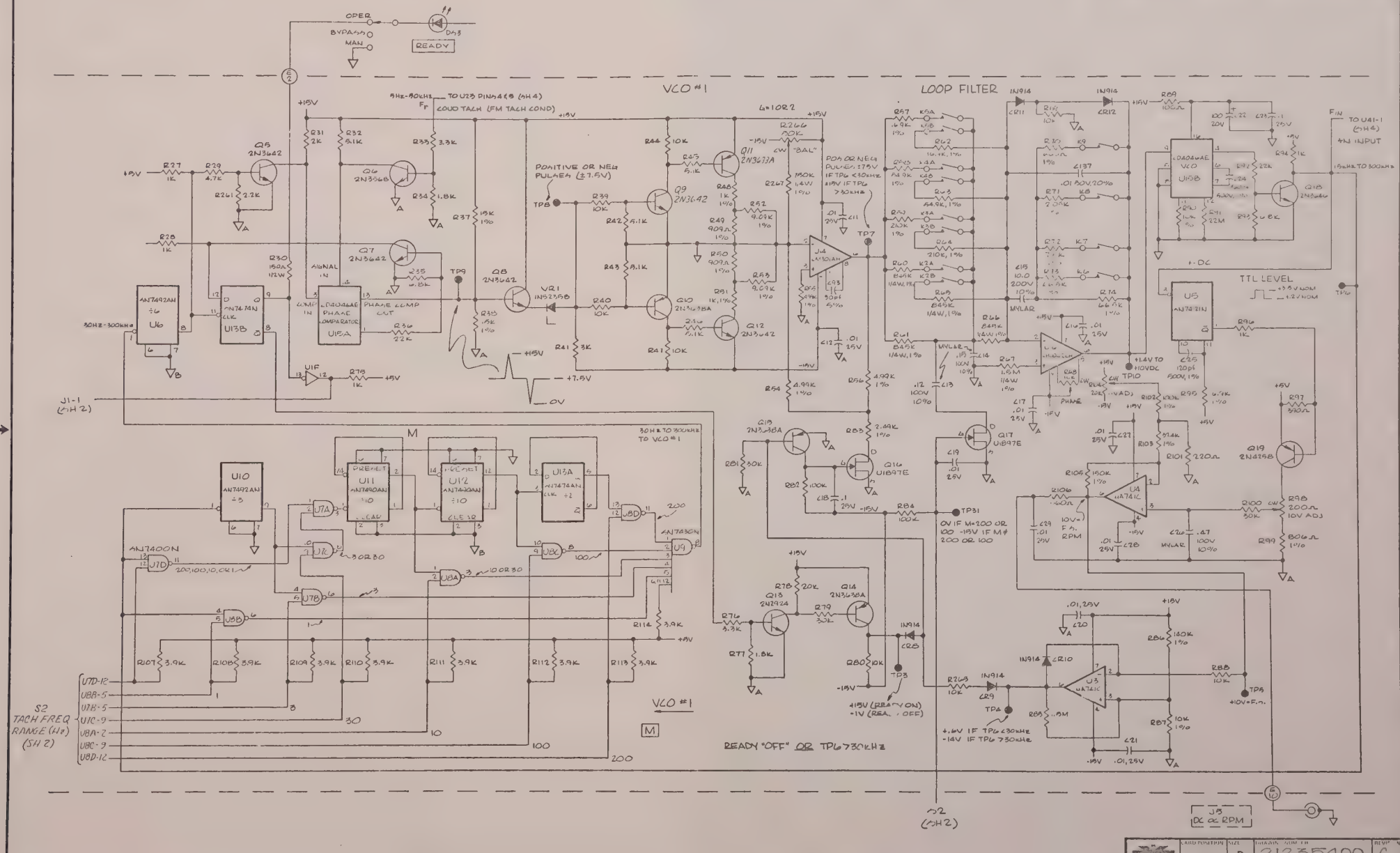
Table B-1. List of Drawings

Reference Designator	Title	Drawing No.
A1A1	VCO Schematic	21235400
	VCO Assembly	21235200
A1A2	Filter Schematic	10072900
	Filter Assembly	10072800
A1A3	Power Supply Schematic	10071700
	Power Supply Assembly	10071800
A1A4	Multiplier Schematic	21185800
	Multiplier Assembly	21185600
None	Interconnection Diagram	21189200

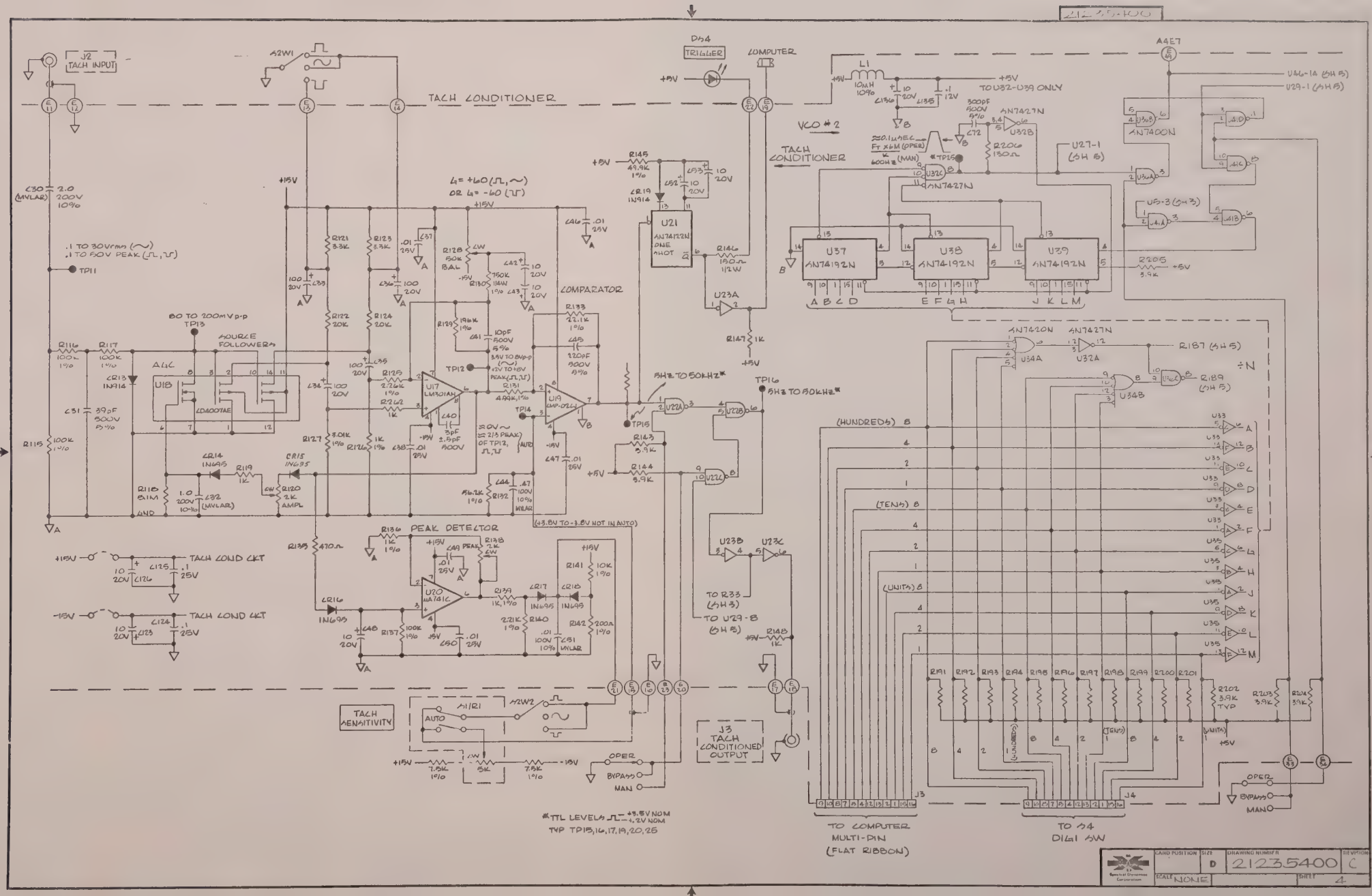

INPUT CIRCUIT (SH 2)
J1 DATA IN
ZIN=100K
ATTEN
.1Vrms=F.S.
TP1
INPUT AMPL
+5V OVERLOAD
TO FILTER (A2)
J7
RANGE HZ | M | ÷
400-50K | 1 | 6
120-17K | 3 | 18
40-5K | 10 | 60
17-1.7K | 30 | 180
10-500 | 100 | 600
5-250 | 200 | 200
VCO #1 (SH 3)
COND TACH
PHASE DETECTOR 1
TP7
LOOP FILTER
TP10
VCO #1
f-DC
J5 DC ∝ RPM
F5=10V
OPER
BYPASS MAN
READY
M
÷6 ÷3 ÷10 ÷10 ÷2
TP16
RANGE/MULT
J3 TACH CONDITIONED OUTPUT
TACH CONDITIONER (SH 4)
J2 TACH INPUT
FT
TP11
SWITCHING
COMPARATOR
TP16
PEAK DETECTOR
SWITCHING
ONE SHOT
+V SENSITIVITY -V
TRIGGER
+5V
FC
VCO #2 (SH 5)
÷6
100KHz OSCILLATOR
TP19
TP17
÷1000
100Hz
TP18
VCO #2
TP22
PHASE DETECTOR 2
TP20 (KX600)
+V
OPER
BYPASS MAN
K
10's
100's
4-UNITS
÷N (SH 4)
TP25
÷N
TO A4 (MULT BOARD)
BLOCK DIAGRAM
VCO SCHEMATIC
OPER INDICATES GATING FUNCTION
BYPASS
MANUAL
2. ALL RELAYS ACTIVATED IN MANUAL OR OPERATE MODE.
BANDWIDTH RANGING (SH 6)
÷2
GATING FUNCTION
10-1K
30-5K
200-20K
OUT
÷8
÷4
F5=3KHZ
f-DC
F5=4KHZ
f-DC
TP27
TP26
LARGER THAN GATE
TP28
METER DRIVER
TP30
DC ∝ BW TO FILTER (A2)
M1
10V CLAMP
0.5V CLAMP
+5V LIMIT
A1
A3P1
A1J2
A1J5
A1J1
+15V
-14.4V
-5V
GND A
+5V
GND B
TO A3 POWER SUPPLY
TO USB (DC ∝ BW)
NOTES: UNLESS OTHERWISE INDICATED
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1/4 W, 5%
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS ±20%, .01 TO 4.1μF TO 25V ARE +80-20%
2. SYMBOL INDICATES FRONT PANEL LOCATION
3. SYMBOL INDICATES CHASSIS LOCATION
4. FACTORY SELECT WITH TYPICAL VALUE SHOWN
5. J2,J5 CONN: (POWER DISTRIBUTION)
INTEGRATED CIRCUITS
REF DESIG | PART NO | PWR PINS GND | PWR PINS +5V | UNUSED CIRCUITS
U1,19,22,36,41,49 | SN74001J | 7 | 14 | U22-D
U2,23,33,35 | SN7403N | 7 | 14 | U49-B
U4,6 | SN7404J | 7 | 14 | U1-A,D,E
U5 | SN74123N | 7 | 14 | U23 D,E,F
U34 | SN74221N | 7 | 14 | U40
U32 | SN74279N | 7 | 14 | U43-45
U9 | SN74393N | 7 | 14 |
U47 | SN7473N | 11 | 4 |
U13 | SN7474N | 7 | 14 |
U11,12,24-26,46 | SN74040J | 10 | 5 |
U6,10,27,29 | SN7492AN | 10 | 5 |
U8,53 | SN74121N | 7 | 14 |
U21,50 | SN74123N | 7 | 14 |
U37-39 | SN74192N | 8 | 16 |
U44 | SN7493AN | 10 | 5 |
U18 | CD4007AE | 7,EE | CIRCUIT |
U31 | CD4011AE | 7 | +5V PINS |
U15,30 | CD4046AE | EE | CIRCUIT |
U9 | LMP-02CJ | | |
U16,28 | LH0042CH | | |
U14,17 | LM301AH | | |
U2 | LF356N | EE | CIRCUIT |
U3-4,20,51,52, 54-58 | uA741C | EE | CIRCUIT
HIGHEST REF DESIG USED
C137
CR6
E49
J5
K10
L1
Q35
R267
A2
TP31
U58
VR1
Y1
UNUSED DESIGNATORS:
C5,6,111
E29,31,38
RH,15,208-211
Q1
CR2,3
PWA - 21235200
PWB - 21235300
A1
NOTES UNLESS OTHERWISE SPECIFIED
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO
TITLE
SCHEMATIC VCO
MODEL SD346
SIZE D
DRAWING NO 21235400
REV C
SCALE NONE
SHEET 1 OF 6



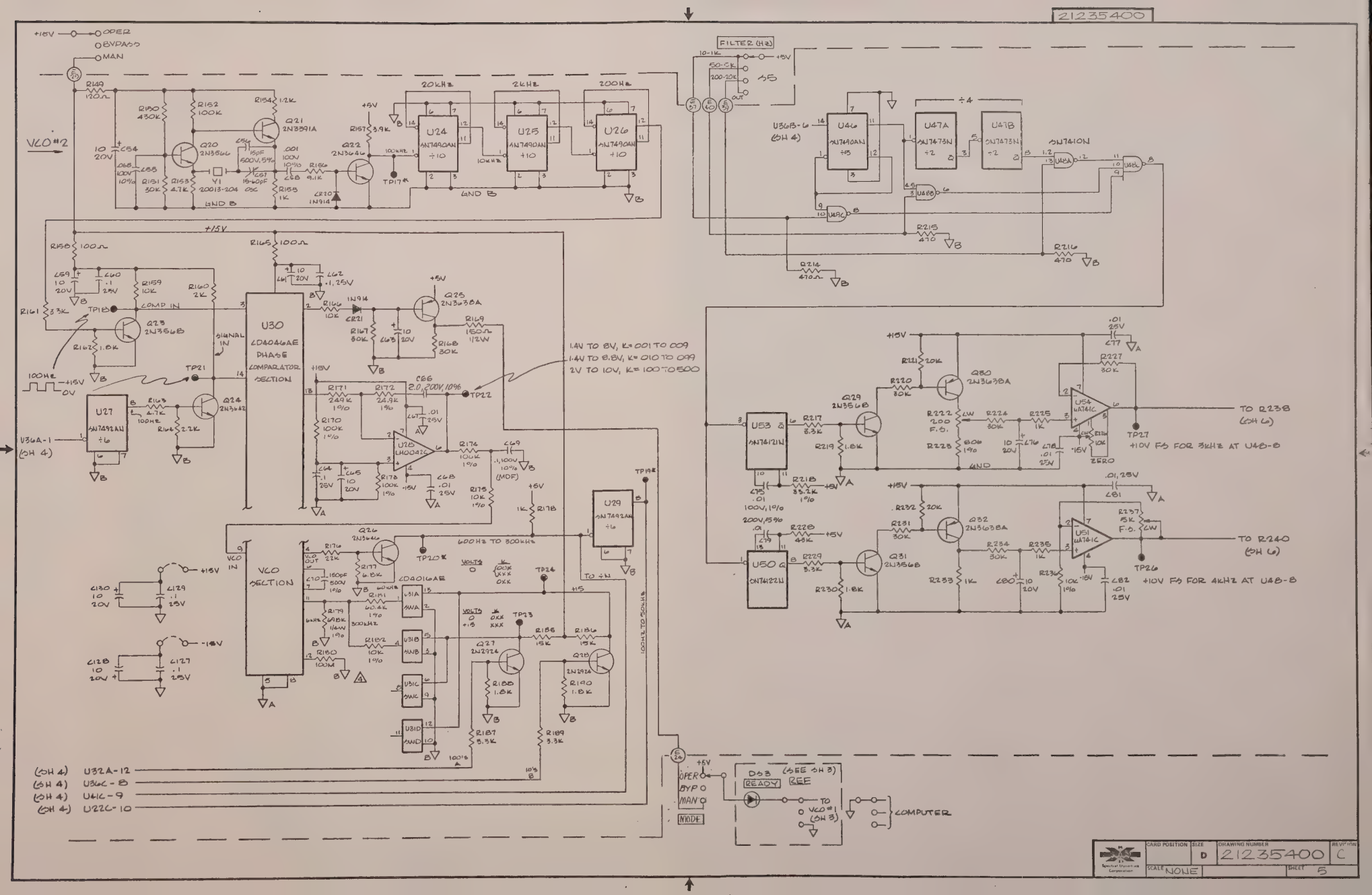
Spectral Dynamics Corporation	CARD POSITION	SIZE D	DRAWING NUMBER 21235400	REVISION C
	SCALE NONE		SHEET 2	



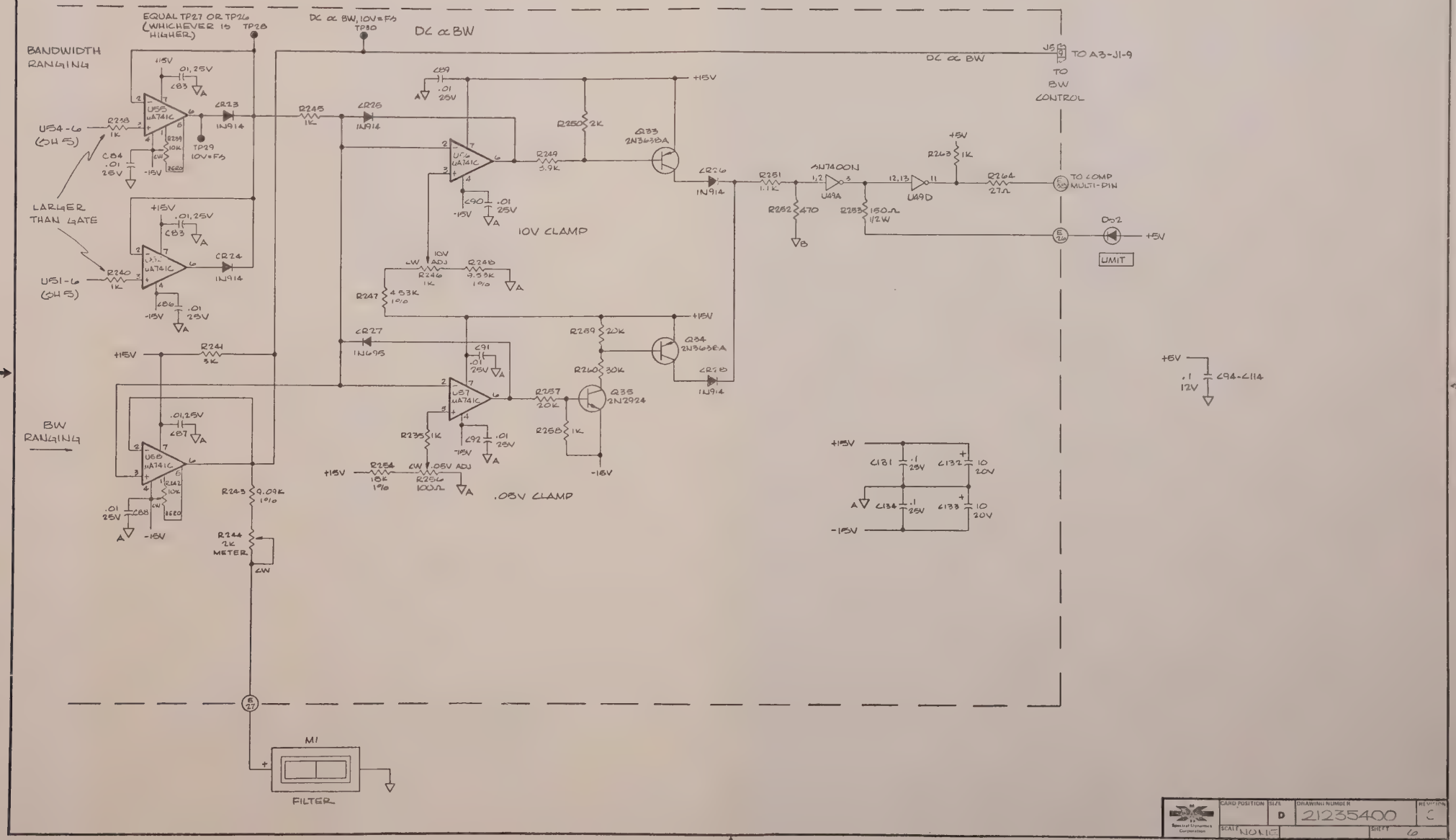
	CAGE NUMBER	SIZE	DRAWING NUMBER	REV
		D	21235400	C
SCALE NONE			SHEET 3	



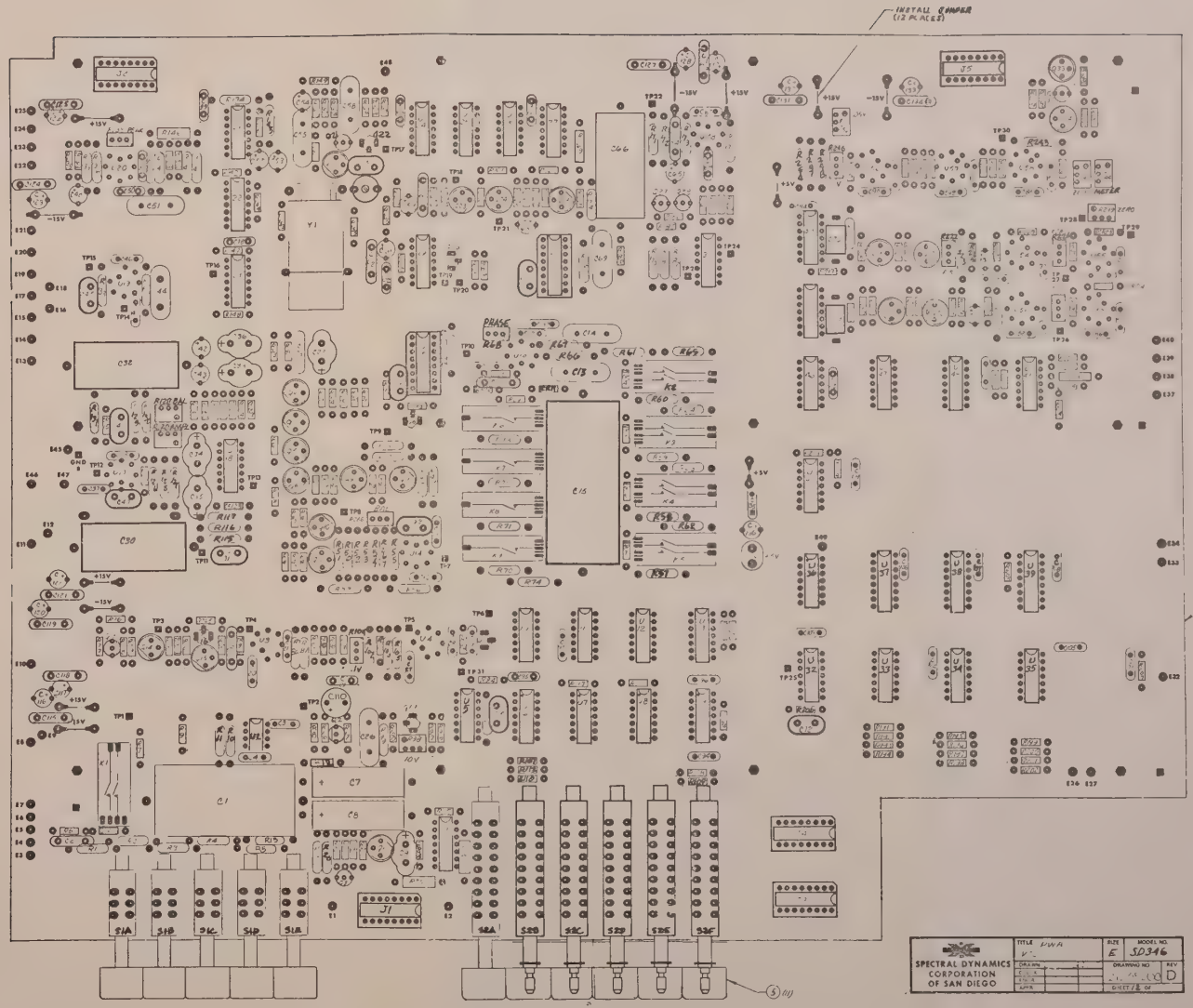
CARD POSITION	SIZE	DRAWING NUMBER	REVISION
	D	21235400	C
SCALE NONE		SHEET 4	

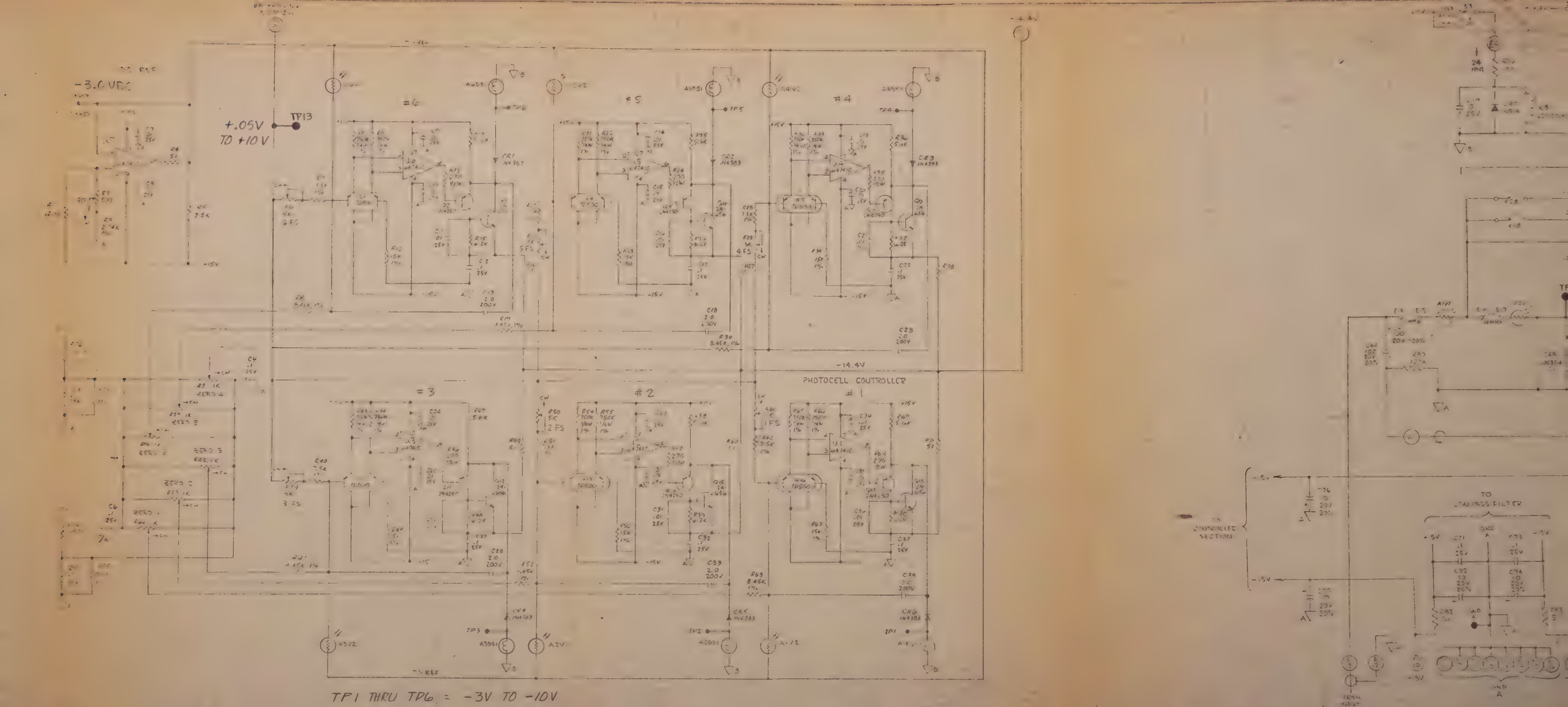


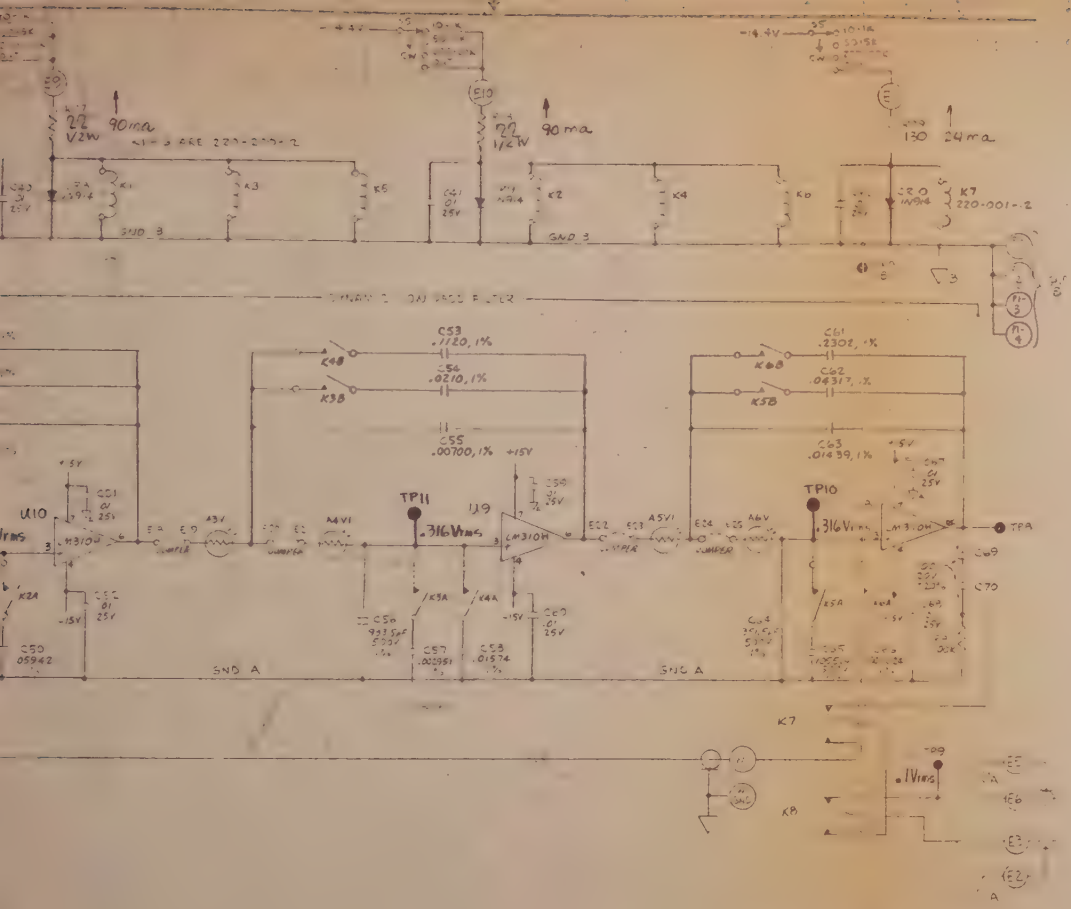
CARD POSITION	SIZE	DRAWING NUMBER	REVISION
	D	21235400	C
SCALE NONE		SHEET 5	

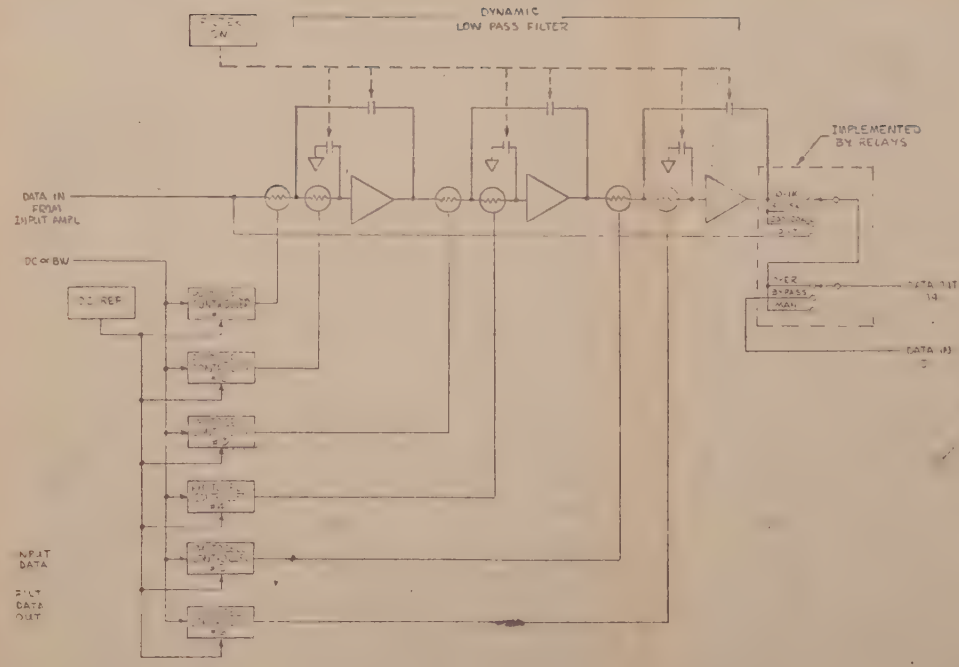


CARD POSITION	SIZE	DRAWING NUMBER		REVISION
	D	21235400		C
SCALE NONE			SHEET 10	


INSTALL JUMPER (12 PLACES)
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO
SIZE E
MODEL NO. SD346
REV D


-3.0 VDC
+.05V TO +10V
TP13
#6
#5
#4
#3
#2
#1
PHOTOCELL CONTROLLER
-14.4V
TP1 THRU TP6 = -3V TO -10V
24 ma
TO LOW PASS FILTER
CONTROLLER SECTION





TP's SHOWN FOR FULL SCALE INPUT SINE WAVE ON .1 Vrms RANGE WITH F (DATA) WITHIN PASS BAND OF FILTER.

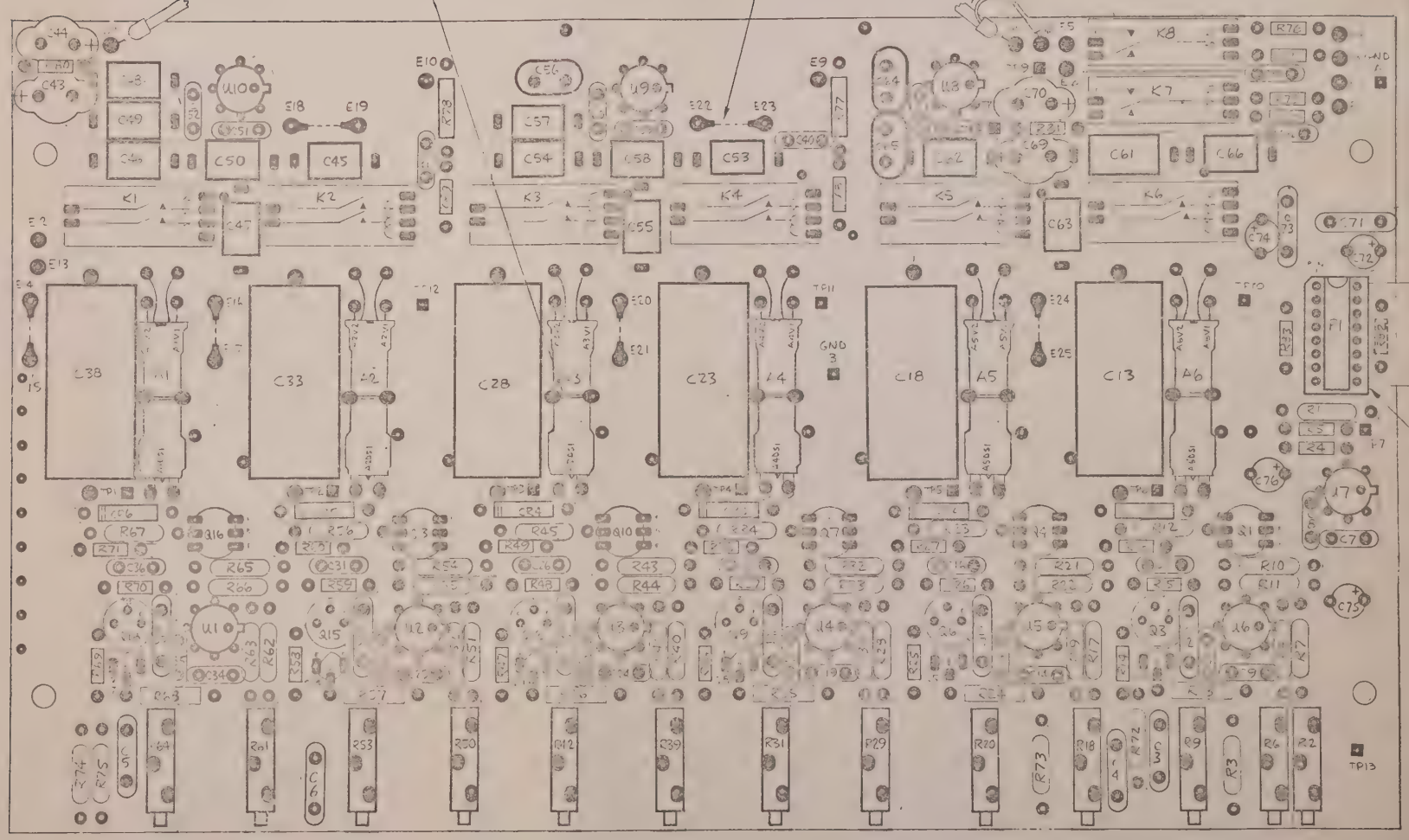
BLOCK DIAGRAM

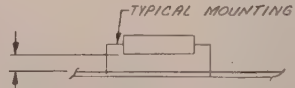
A		C11	RELEASED	4-18-73	DP
B	4523		P77.78 WAS 320	1-19-76	D. B

PC 3[illegible]-10072700
PC ASSY-10072000
KEY - NONE

A2

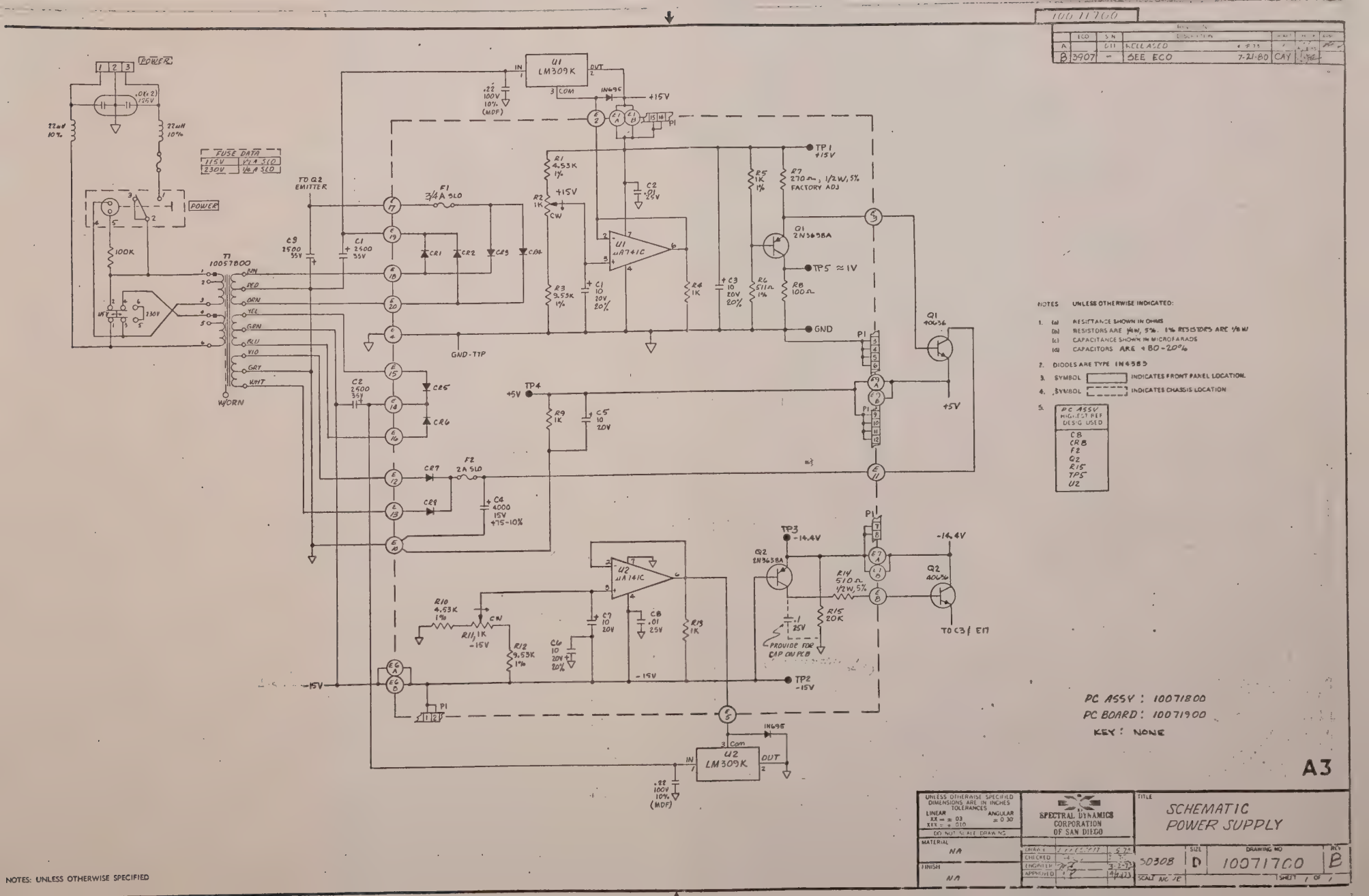
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO	DYNAMIC FILTER		

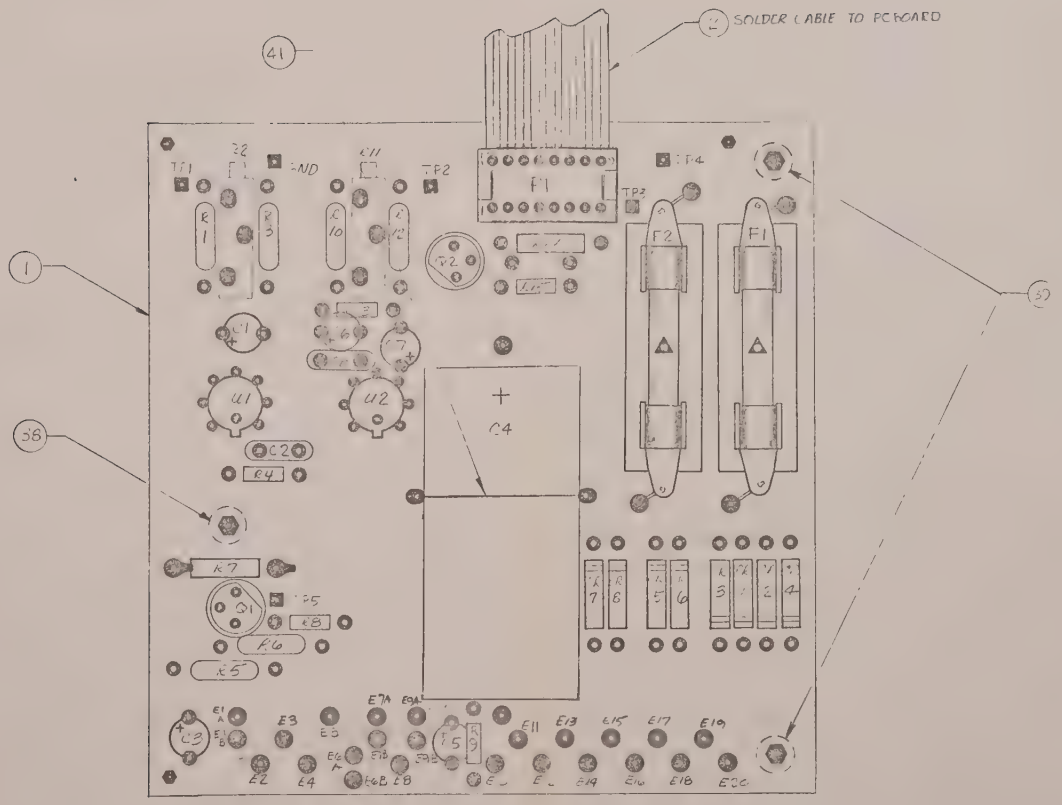


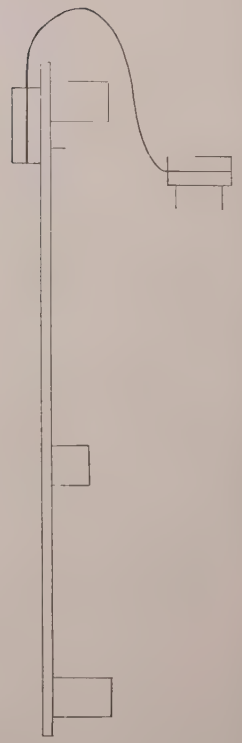


MTG DETAIL

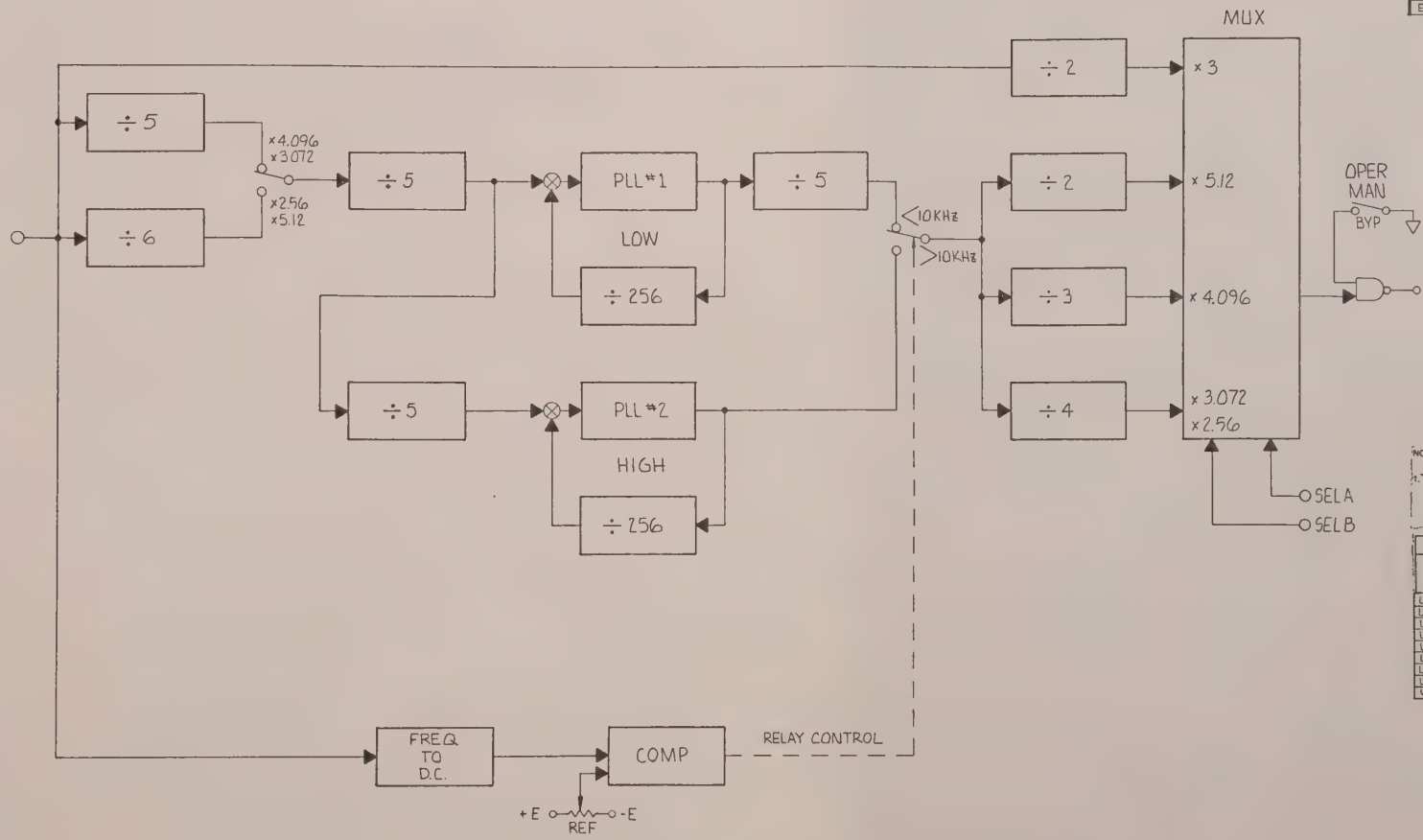
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO	TITLE PC ASSY- FILTER		SIZE C	MODEL NO. SD308	
	DRAWN	[illegible]	5-12-83	DRAWING NO. 10072800	REV D
	CHECK				
	ENGR		5/16/83		
	APPR			SHEET 1 OF	


10011760
REVISIONS
ECO S/N DESCRIPTION DRAWN CHK APVD
A 611 RELEASED 4-23-80
B 3907 -- SEE ECO 7-21-80 CAY
POWER
22uH 10%
22uH 10%
.01(x2) 1500V
FUSE DATA
115V 1/4 A SLO
230V 1/8 A SLO
POWER
100K
T1 10057800
WHT
115V
230V
BRN
RED
ORN
YEL
GRN
BLU
VIO
GRY
WHT
WORN
TO Q2 EMITTER
C9 2500 35V
C1 2500 35V
F1 3/4 A SLO
CR1
CR2
CR3
CR4
GND-TTP
C2 2500 35V
CR5
CR6
CR7
CR8
F2 2A SLO
C4 4000 15V +75-10%
-15V
U1 LM309K
IN
OUT
COM
.22 100V 10% (MDF)
IN696
+15V
R1 4.53K 1%
R2 1K CW
+15V
C2 .01 25V
U1 μA741C
R3 9.53K 1%
C1 10 20V 20%
R4 1K
C3 10 20V 20%
R5 1K 1%
R7 270Ω, 1/2W, 5% FACTORY ADJ
Q1 2N3638A
R6 511Ω 1%
R8 100Ω
TP1 +15V
TP5 ≈ 1V
GND
Q1 40636
+5V
TP4
R9 1K
C5 10 20V
U2 μA741C
R10 4.53K 1%
R11 1K CW
-15V
R12 9.53K 1%
C6 10 20V 20%
C7 10 20V
C8 .01 25V
R13 1K
TP2 -15V
U2 LM309K
.98 100V 10% (MDF)
TP3 -14.4V
Q2 2N3638A
R14 510Ω 1/2W, 5%
R15 20K
.1 25V
PROVIDE FOR CAP ON PCB
-14.4V
Q2 40636
TO C3 f EM
P1
PC ASSY HIGHEST REF DESG USED
C8
CR8
F2
Q2
R15
TP5
U2
NOTES UNLESS OTHERWISE INDICATED:
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1/4W, 5%. 1% RESISTORS ARE 1/8 W
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS ARE +80-20%
2. DIODES ARE TYPE IN4585
3. SYMBOL INDICATES FRONT PANEL LOCATION.
4. SYMBOL INDICATES CHASSIS LOCATION
5.
PC ASSY 10071800
PC BOARD: 10071900
KEY: NONE
A3
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES
LINEAR XX = ± .03 XXX = ± .010
ANGULAR ± 0 30'
DO NOT SCALE DRAWING
MATERIAL NA
FINISH NA
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO
DRAWN 4-23-80
CHECKED
ENGINEER
APPROVED
TITLE SCHEMATIC POWER SUPPLY
SIZE D
DRAWING NO 10071700
REV B
SCALE NONE
SHEET 1 OF 1
NOTES: UNLESS OTHERWISE SPECIFIED





SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO	TITLE PC ASSY POWER SUPPLY	SIZE C	MODEL NO. SD308
	DRAWN	DRAWING NO 071600	REV C
	CHECK		
	ENGR		
	APPR	SHEET 4 OF	



REVISIONS				
REV	ECO	S/N	DESCRIPTION	
A	—	—	RELEASED	
B	3573	—	PER ECO	10-30-79
C	AL46	—	PER ECO	
D	3762	—	SEE E.C.O.	
E	4147	—	C7 WAS 2uF, 100V, 10%	1-25-81

HIGHEST REF. DESIG USED
A—
C21
CR—
E17
L—
Q7
R37
S—
T—
TP5
U13
VR—

NOTES: UNLESS OTHERWISE INDICATED:
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE 1/4W, 5%; 1% ARE 1/8W
(c) CAPACITANCE SHOWN IN MICROFARADS!
(d) CAPACITORS ARE 20%, 01 ARE 25V, +80-20%

INTEGRATED CIRCUITS

REF DESIG	PART NO	PWR PINS GND	PWR PINS +5V	UNUSED CIRCUITS
U6,11	CD4046AE	SEE CKT	SEE CKT	
U3	CMD07CJ	SEE CKT	SEE CKT	
U4	SN7400N	7	14	
U12,13	SN7492AN	10	5	
U8	SN7412N	7	14	
U1	SN7403N	8	16	
U5,10	SN74390N	8	16	
U7,12	SN74393N	7	14	
U9	SN74S74N	7	14	

PWA- 21185600
PWB- 21185700

A4

NOTES UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES LINEAR XX ± .03 XXX ± .010 ANGULAR ± 0 30
DO NOT SCALE DRAWING
MATERIAL
FINISH

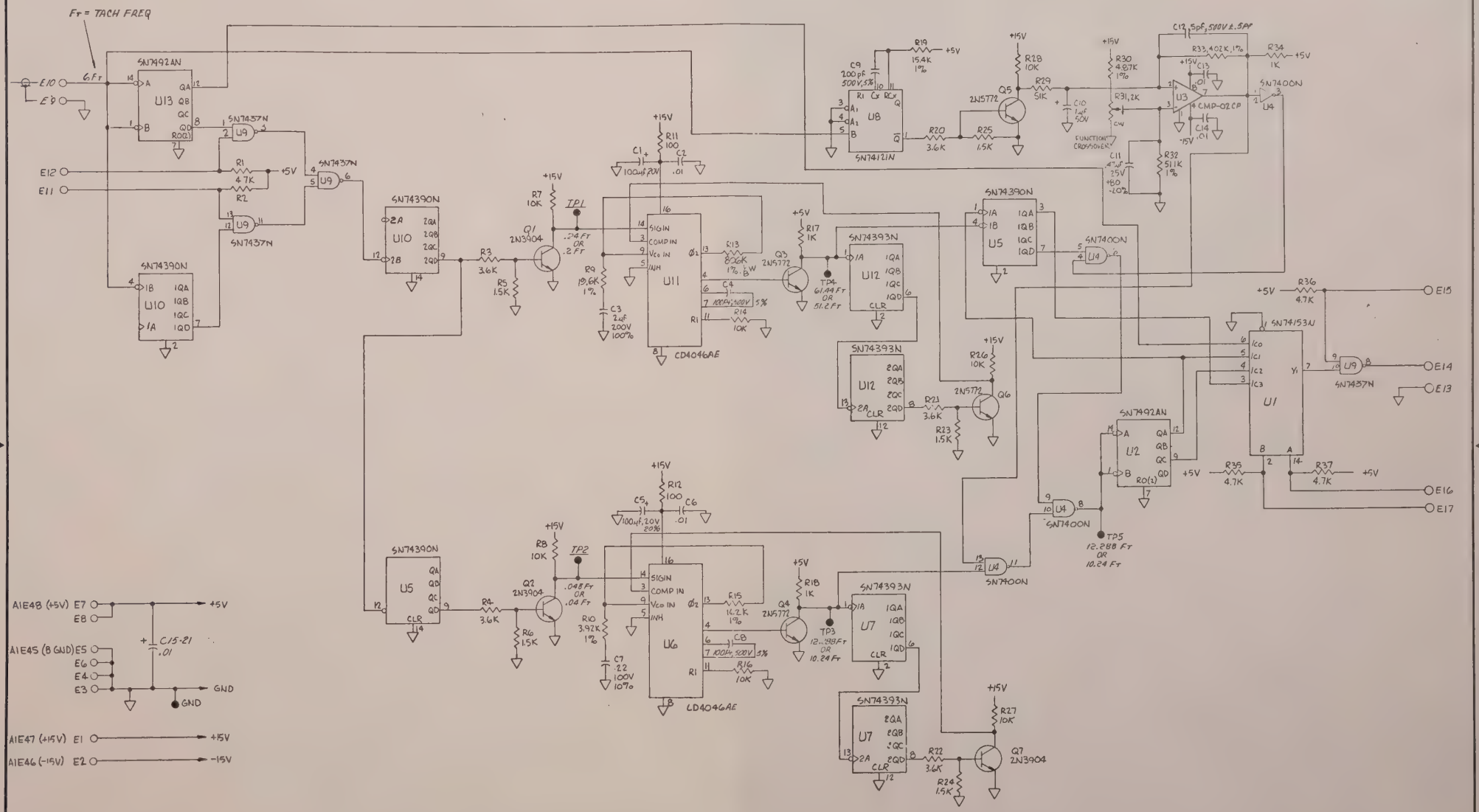
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO

DRAWN
DESIGNER
CHECKED
ENGINEER
APPROVED

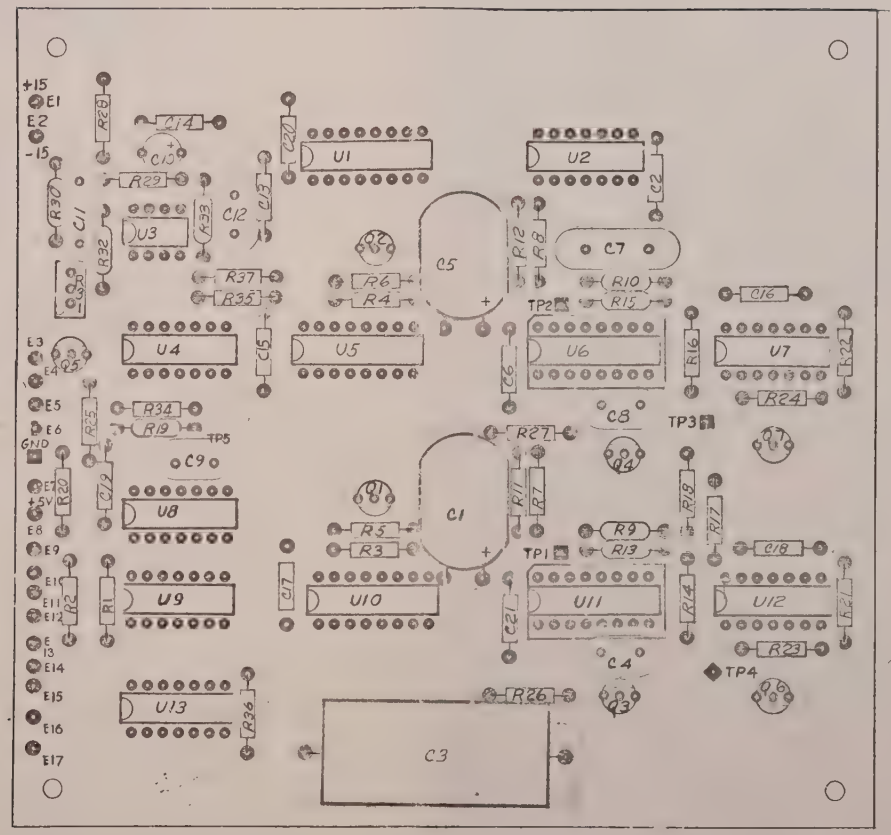
TITLE SCHEMATIC— MULTIPLIER

MODEL	SIZE	DRAWING NO.	REV
SD346	D	21185800	E

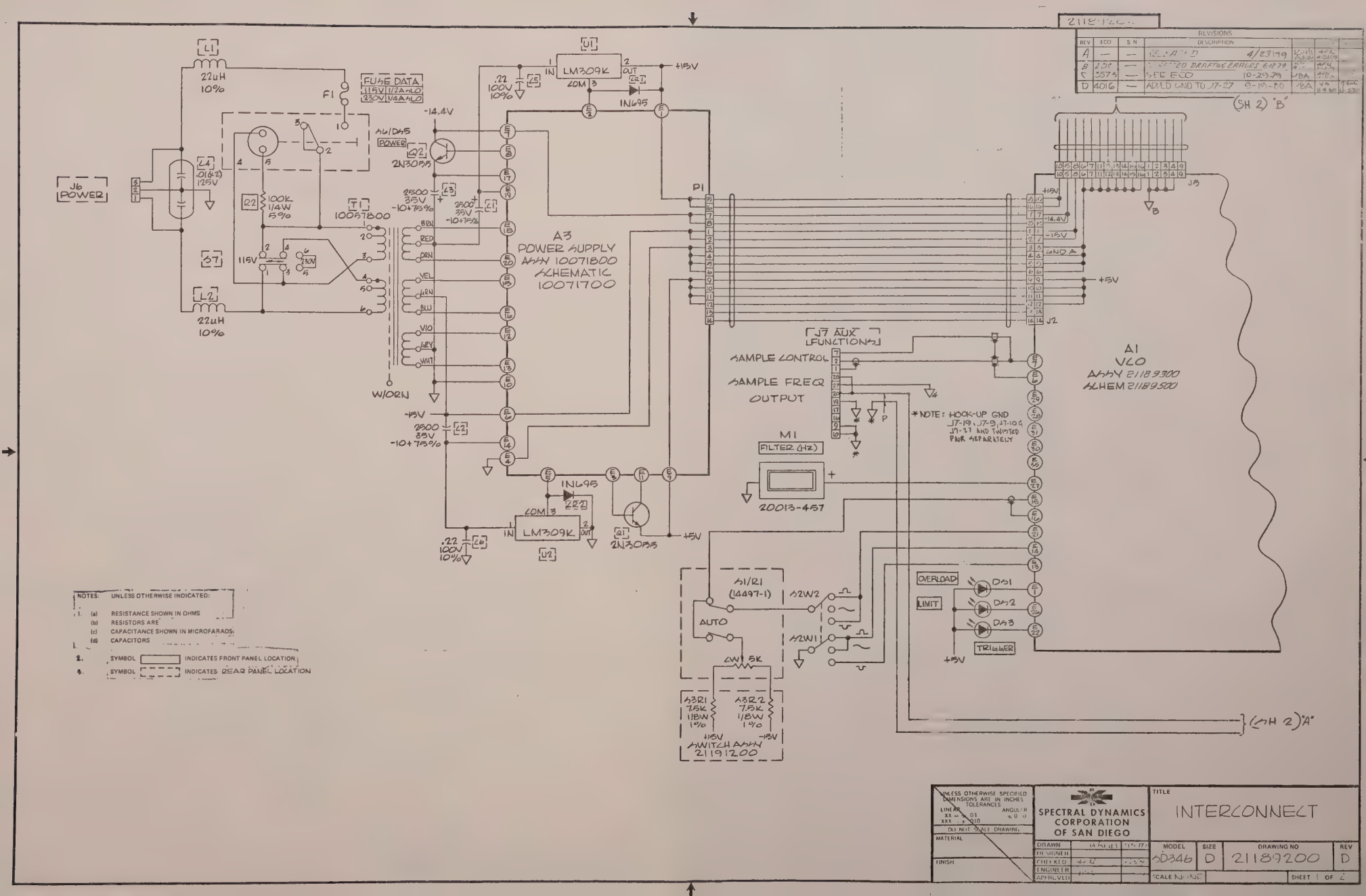
SCALE NONE SHEET 1 OF 2

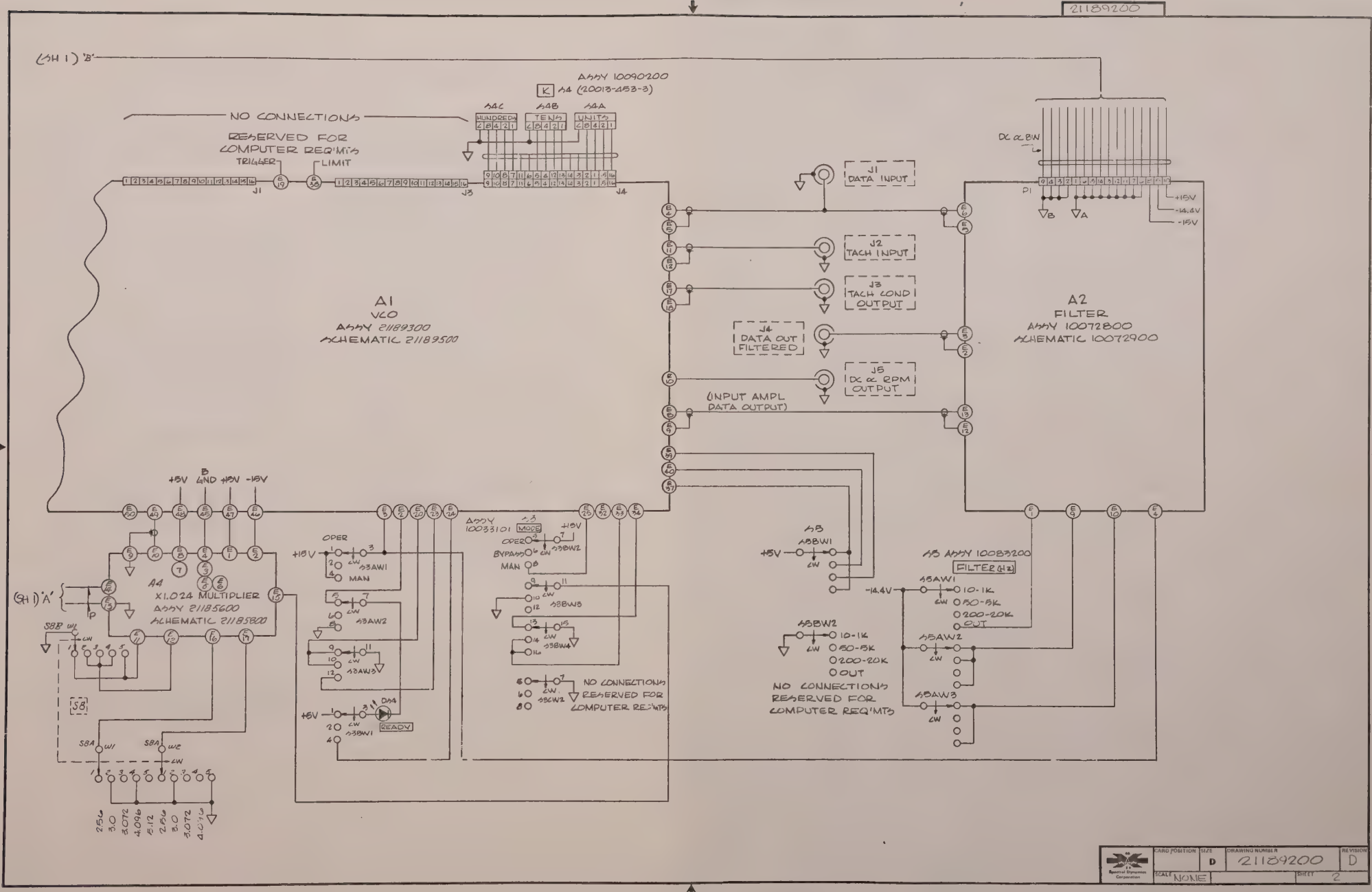


CAGE	CARD POSITION	SIZE	DRAWING NUMBER	REVISION
Space Systems Corporation	A4	D	21185800	E
	SCALE NONE		SHEET 2	



SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO	TITLE PWA — MULTIPLIER	SIZE C	MODEL NO. SD346
	DRAWN	DRAWING NO. 21185600	REV E
	CHECK		
	ENGR		
	APPR	SHEET OF	


REVISIONS
REV ECO S N DESCRIPTION
A — — RELEASED 4/23/79
B 2.5A — CORRECTED DRAFTING ERRORS 6/12/79
C 3575 — SEE ECO 10-29-79
D 4016 — ADDED GND TO J7-27 9-10-80
J6 POWER
F1
FUSE DATA
115V 1/2A SLO
230V 1/4A SLO
L1 22uH 10%
L2 22uH 10%
L4 .01(X2) 125V
J7
115V
230V
Q2 2N3055
R2 100K 1/4W 5%
T1 10037800
WORN
RED
ORN
YEL
GRN
BLU
VIO
GRY
WHT
-14.4V
+15V
-15V
2800 35V -10+75%
.22 100V 10%
U1 LM309K
U2 LM309K
IN695
Q1 2N3053
A3
POWER SUPPLY
ASSY 10071800
SCHEMATIC
10071700
P1
J2
J3
(SH 2) "B"
(SH 2) "A"
J7 AUX FUNCTIONS
SAMPLE CONTROL
SAMPLE FREQ OUTPUT
*NOTE: HOOK-UP GND J7-19, J7-9, J7-10 & J9-27 AND TWISTED PAIR SEPARATELY
M1
FILTER (Hz)
20013-457
A1
VCO
ASSY 21189300
SCHEM 21189500
S1/R1 (14497-1)
AUTO
S2W2
S2W1
CW1 5K
A3R1 7.5K 1/8W 1%
A3R2 7.5K 1/8W 1%
SWITCH ASSY 21191200
OVERLOAD
LIMIT
TRIGGER
D31
D32
D33
NOTES: UNLESS OTHERWISE INDICATED:
1. (a) RESISTANCE SHOWN IN OHMS
(b) RESISTORS ARE
(c) CAPACITANCE SHOWN IN MICROFARADS
(d) CAPACITORS
2. SYMBOL INDICATES FRONT PANEL LOCATION
3. SYMBOL INDICATES REAR PANEL LOCATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES
DO NOT SCALE DRAWING
MATERIAL
FINISH
SPECTRAL DYNAMICS CORPORATION OF SAN DIEGO
DRAWN
DESIGNED
CHECKED
ENGINEER
APPROVED
TITLE
INTERCONNECT
MODEL SD346
SIZE D
DRAWING NO 21189200
REV D
SCALE NONE
SHEET 1 OF 2



CARD POSITION	SIZE	DRAWING NUMBER	REVISION
	D	21189200	D
SCALE NONE		SHEET 2	

Scientific-Atlanta Service Information

Scientific-Atlanta has sales and service centers around the world. In addition, an international network of sales representatives is available to assist you anywhere in the world.

Product Support Programs

Customer Support

At Scientific-Atlanta, we are committed to supporting the instruments we sell. This philosophy is demonstrated through a world-wide sales and service organization which provides a variety of services to our customers.

Service Centers

Scientific-Atlanta maintains a network of service centers around the world. These centers are staffed and equipped to handle most maintenance requirements. In addition, the service center can provide technical assistance on problems related to the application, operation, or maintenance of our products.

- Service representatives are factory trained on each product.
- Specialized knowledge and test equipment is available to provide local repair with minimum downtime.
- The service representatives have the experience to provide on-site calibration and maintenance of individual instruments or entire systems.

To insure continued customer satisfaction, each service center is equipped to provide several types of service:

Warranty Service

Each Scientific-Atlanta manufactured instrument is tested and inspected to conform to its published specifications and to be free of defects in materials and workmanship. Scientific-Atlanta will repair or replace products which prove to be defective within the warranty period. Detailed warranty information is included in the applicable instrument instruction manual. For more information, contact the Scientific-Atlanta office nearest you.

If an instrument develops a defect within the warranty period, contact your Scientific-Atlanta service center. Your Service Representative will help determine the best course of action for effecting the repair of your equipment; all without parts or labor expense to you.

Annual Service Agreement

An annual service agreement is an economical and effective way to assure continued high instrument performance. Periodic scheduled maintenance and calibration is the best insurance against equipment failure. It is a cost-effective means of preventing expensive production interruptions or delays in development programs. You are assured of timely, competent service without the expense of maintaining in-house maintenance capability, specialized test equipment, and replacement parts inventories.

Some of the outstanding advantages of an Annual Service Agreement are:

- Regularly scheduled maintenance and calibration.
- Reduced labor rates — approximately 20% saving over unscheduled field service.
- Quick response on emergency service — normally within 48 hours.
- Facilitates maintenance budgeting.
- Minimizes paperwork — one purchase order covers the entire year.
- On-site service of instruments or entire system — reduces downtime, eliminates problems related to sending individual instruments to the calibration laboratory.

Field Service

Field Service is available to assist you with stubborn maintenance problems, installations, and other technical problems. If field service is required, contact your Scientific-Atlanta service center.

In-House Service

In some cases it is more efficient or cost effective to return equipment to our service center. Your Service Representative will gladly work with you to determine when this is necessary and will provide you with shipping instructions.

Replacement Parts

Each service center maintains inventories of most replacement parts for current standard products. In most cases, emergency orders for parts, printed circuit boards, subassemblies, and supplies can be filled within 24 hours. Ordering parts from Scientific-Atlanta provides you with a single source of supply and assurance of part compatibility.

When ordering parts from Scientific-Atlanta, please provide a description, part number, model number, and serial number.

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Washington Business Park
5100-J Philadelphia Way
Lanham, MD 20706-4497
Telephone: (301) 577-4830

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Cleveland, OH 44122
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